



CHEMONICS INTERNATIONAL INC.



Subsector Assessment of the Nigerian Shrimp and Prawn Industry



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FOREWORD

Under the Rural and Agricultural Incomes with a Sustainable Environment (RAISE) IQC, Chemonics International and its Agricultural Development Assistance in Nigeria (ADAN) project are working with USAID/Nigeria and the Government of the Federal Republic of Nigeria (GON) to stimulate Nigeria's economic growth through increased competitiveness in the world market. A key component of this effort centers on determination of specific agricultural products with the greatest potential for increasing foreign exchange and employment. ADAN specifically targets increased agricultural commodity production and exports, and seeks to boost domestic sales as well through opportunistic 'fast track' activities, which are loosely based on development of networks and linkages to expedite trade.

At a stakeholders' conference in Abuja, Nigeria in January 2002, participants identified five Nigerian products that held the greatest potential for export growth. Chemonics/ADAN was charged with conducting sub-sector assessments of these products, and then developing industry action plans (IAPs) for those that indicated sufficient market opportunities.

The following sub-sector assessment examines market trends, opportunities and constraints, both international and domestic; production and processing requirements; operating environment issues; and recommendations to address the needs of the Nigerian industries. A separate IAP provides a strategic framework for actions, which the Nigerian and international private sector, Nigerian government, and donors should undertake to improve the viability of these industry clusters.

In the course of carrying out this sub-sector assessment, the Nigerian Institute for Oceanography and Marine Research (NIOMR) played a very active role in providing invaluable information and necessary guidance in the course of our research.

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ACRONYMS AND TERMS

FDF	Federal Department of Fisheries
FMARD	Federal Ministry of Agriculture and Rural Development
GAA	Global Aquaculture Alliance
MSY	Maximum Sustainable Yield
NAFDAC	National Agency for Food and Drug Administration and Control
NIOMR	Nigerian Institute for Oceanography and Marine Research
NITOA	Nigerian Trawler Owners Association
NMFS	National Marine Fisheries Service (USA)
OECD	Organization for Economic Cooperation and Development –shorthand for wealthy western and eastern states including North America, Europe and Japan
PCU	Projects Coordinating Unit, Federal Ministry of Agriculture and Rural Development
Prawns:	Taken to mean freshwater prawns (<i>Macrobrachium</i>) here
PUD	Peeled but un-deveined shrimp tails (i.e. with gut left in)
PandD	Peeled and deveined shrimp tails
Shrimp	Taken to mean marine/brackish water shrimp (<i>Penaeids</i>) here

Marine/brackish water shrimp

<i>Penaeus vannamei</i>	Farmed white shrimp (From Pacific coast Latin America)
<i>Penaeus notialis</i>	Nigerian “white” shrimp
<i>Penaeus monodon</i>	Farmed Asian giant tiger shrimp

Freshwater Prawns

<i>Macrobrachium rosenbergii</i>	Malaysian giant freshwater prawn (widely farmed)
<i>M. vollehovenii</i>	Nigerian giant prawn, caught commercially: potentially farmable
<i>M. macrobrachion</i>	A small Nigerian prawn caught commercially

Exchange rate: 130 Naira per \$US (August 2002)

EXECUTIVE SUMMARY

Shrimp is a huge global seafood industry valued at over US\$18 billion and growing at 3% annually. The dominant player is the OECD market – US, Europe and Japan - with the US market growing at 5% p.a. Production, of both wild captured and farmed shrimp, has shown a steady increase to meet this demand with farmed shrimp contributing 25% and is estimated to increase to 50% of total production. S.E. Asia is the major producer and has benefited the most from this upsurge in farmed shrimp production. However, there is room for other producers assuming they can establish competitively priced farms. With that in mind, Nigerian stakeholders can, potentially, increase their current market size to over US\$300 million in the next ten years, with an almost twenty five fold increase in the industry's employment level (see Table 1).

Table 1: Income Generation and Job Creation (estimated)

Criteria	Base yr (2003)	2 yrs (2005)	5 yrs (2008)	10 yrs (2012)
Total Export Earnings	\$56.0 M	\$85.0 M	\$168M	\$384M
Total Job Creation	3,300	4,500	26,500	84,000

Nigeria is a maritime country where fishing plays an important role in the national economy, providing employment, food, income and foreign exchange earnings. There is a significant Nigerian wild capture shrimp industry generating US\$57 million per annum in foreign exchange. The rapidly growing catfish aquaculture industry can hardly meet local demand. Nigeria is also blessed with all of the natural resources necessary to become a competitive farm/culture producer. In spite of this, Nigeria is the largest importer of frozen fish in Africa, with annual imports exceeding US\$250 million.

Nigeria faces several challenges including land acquisition and security issues in the areas most suitable for shrimp aquaculture; the petroleum rich Niger Delta. The high cost of capital, lack of encouragement and support for long-term investments, and the fact that shrimp and/or prawn aquaculture technology is currently unavailable and unproven in Nigeria are also challenges.

To exploit this market opportunity, Nigeria needs to increase its shrimp and prawn production to meet both domestic and export demand through aquaculture.

A dual program is proposed: shrimp as a large agribusiness of interest to substantial investors with a mid to long-term investment horizon; while freshwater prawns are seen in terms of improving rural livelihoods. This would be through revenue generating activities that are incremental to existing aquaculture or agricultural activities.

This effort would include 3 major activities upon which to develop further implementation:

- 1.) Full feasibility study
- 2.) Pilot Projects
- 3.) Establishment of a Shrimp/Prawn Action Team

Full feasibility studies are necessary to validate all assumptions and identify appropriate locations for a “pilot” project. Once completed, pilot projects will begin to work through the risks and uncertainties of introducing a new technology. Once the technology is proven and commercially viable, it will be replicated throughout Nigeria. The Shrimp/Prawn “Action Team” would coordinate all activities. Key stakeholders have selected the following members:

- 1 Multinational (Shell Oil Company)
- 1 Private Sector (i.e. Ocean Fisheries)
- 1 Public Sector (Federal Department of Fisheries/PCU)
- 1 Research Institution (NIOMR)
- 1 Commercial Bank (i.e. NACRDB)

I. INTERNATIONAL SHRIMP INDUSTRY

A. Introduction

Shrimp, once regarded as a luxury food by most people, has become more affordable and available as demand for it steadily rises in the major consuming markets of Japan, North America and Europe. It has grown into a significant global seafood industry – producing nearly four million tons worth some \$18 billion annually. Approximately half of the global shrimp supply is traded, with trade flowing mainly from the tropical developing world to the OECD (Organization for Economic Cooperation and Development) countries, i.e. North America, Europe and Japan. The other half is consumed where produced in domestic markets. Shrimp imports by these wealthy markets reached \$7.8 billion last year. Add in domestic production in the USA and Europe (worth around \$0.4bn for each market) and the total OECD market is valued at \$8.6bn.

Table 2: OECD Shrimp trade (import) value: 2001

Country	Imports
USA	\$3.6bn
Japan	\$2.3bn
Europe	\$1.9bn
Total	\$7.8bn

Source: US NMFS, Eurostat (see Annex I)

A.1. Key definitions

There is no generally accepted convention on the terms “shrimp” and “prawns”. We have assigned the term shrimp to mean marine water Penaeids (e.g. the white shrimp caught by Nigerian trawlers in the ocean) while the term prawn refers exclusively to the large freshwater prawns (*Macrobrachium*) produced in Nigeria’s rivers and lakes, and found up to 250 miles inland. This convention is adopted throughout the report.

A.2. Shrimp Biology and the Production Process

Penaeid shrimp (Marine/brackish water)

Penaeid shrimps are the typical tropical shrimp, dominating the market and produced in many areas around Southeast Asia and Latin America. They have been the focus of a major global fishery industry that developed rapidly during the second half of the twentieth century, and have become central to the shrimp farming industry. They live in brackish or reduced salinity water over shallow banks off major river systems.



Figure 1: Typical Penaeid Shrimps

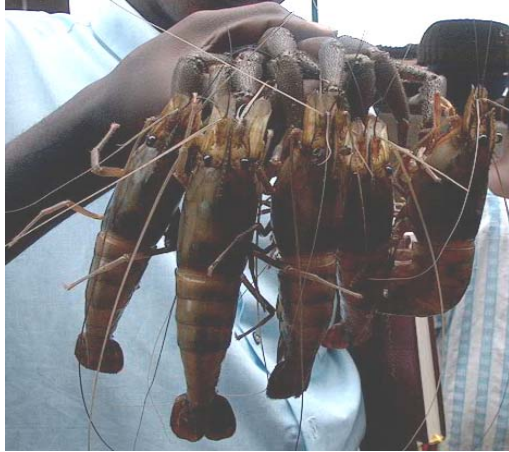


Figure 2: Typical Freshwater Prawns

Freshwater Prawns: Macrobrachium

Freshwater prawns are a separate segment of the market. Traditionally, they were favored in the Thai domestic market and Thailand was the main producer. Recently, China, India and Bangladesh have started to produce them in large quantity. Freshwater prawns are more aggressive than penaeids and thus are not well suited to intensive culture. It appears that recent growth in Indian subcontinent and Chinese production has been the result of rearing *Macrobrachium* at low densities in extant fish farms, in polyculture with carps and tilapia. They then provide additional revenue for little extra work or input. They grow larger than penaeids and the long blue claws of the main farmed species, *Macrobrachium rosenbergii*, make it a restaurant showpiece.

Prawns have a major disadvantage, however, in that they yield only about 40% meat, compared to penaeid shrimps, which yield approximately 60%. This results in significantly lower prices for prawns than for penaeids (on a like for like basis, i.e. comparing the same size grade of tails), providing relatively low financial yields.

B. The Global Marine Shrimp Industry

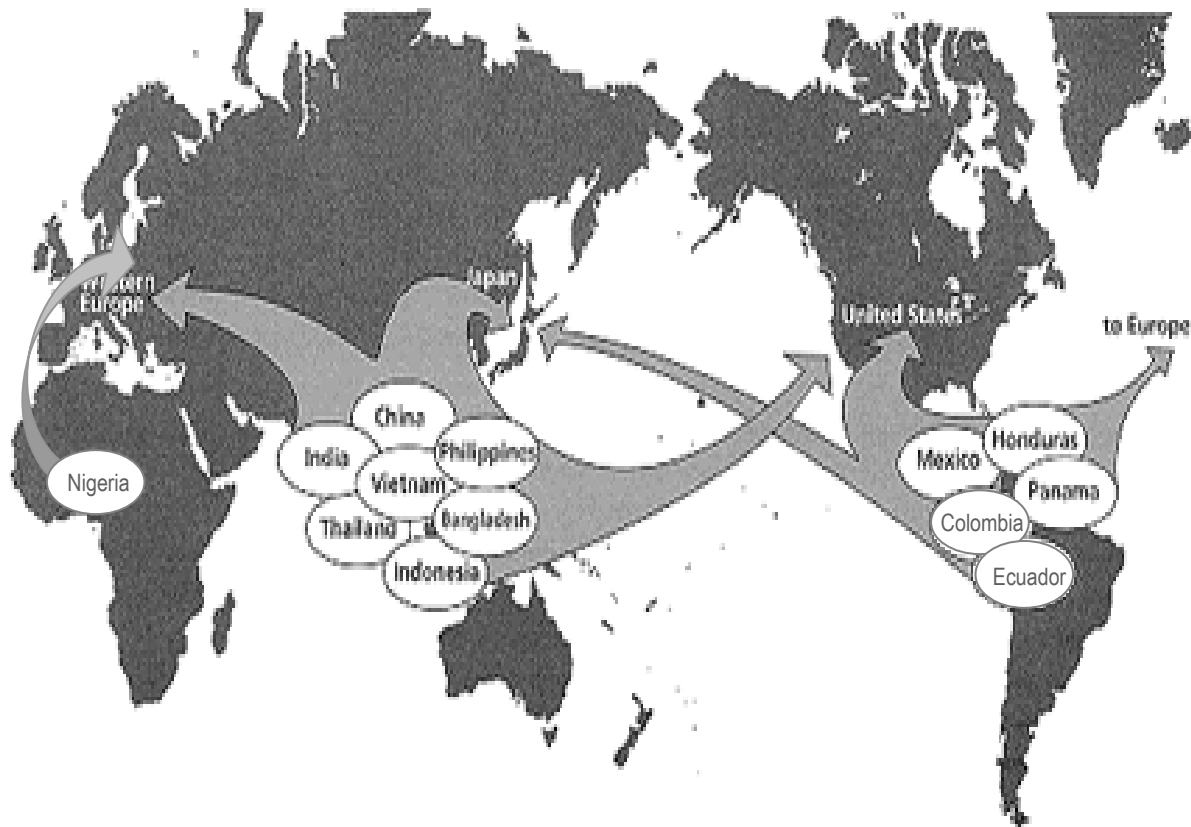
B.1. Producers

Shrimp production, both capture and aquaculture, stands at some 3.8 million tons (up from 2.5 million tons in 1990). China produces about 25% of the world's shrimp, but Indonesia, India and Thailand have registered significant production increases.

Virtually all the world's major stocks of wild shrimp are either fully or over-exploited and wild shrimp capture has hovered around 2 million tons per annum (p.a.) since the early 1980's. This stagnating growth rate, in the face of growing demand, has boosted shrimp aquaculture, as producers search for ways to increase supply. Shrimp farms have developed rapidly during the past 20 years; global production multiplied from 80,000 tons in the early 1990's to 800,000 tons in 2000. Today more than one quarter of shrimp consumed are produced by aquaculture, and this proportion is predicted to rise to 50% in the next couple of years.

Countries have adapted various aquaculture methods. Some countries, such as India, Bangladesh and Thailand, use a system of rice/shrimp rotation that provides low yields from these natural ponds, but is sustainable over long periods. The dominant trend in the last decade, however, has been the development of semi-intensive and intensive farming systems. The downside to this trend is the resulting environmental impact, which increases as the production intensity grows.

Figure 3: Global Shrimp Market



B.2. Farmed shrimp production

The farmed shrimp industry has developed in two main centers:

1. **South America**, where farming white shrimp (*Penaeus vannamei*, 30% of global farmed output during the 1990's) became a major activity, particularly in Ecuador.
2. **South East Asia**, where the large “black tiger” shrimp (*Penaeus monodon* - 60% of global output) dominated the industry, although Asiatic white shrimp (*P chinensis* - 8% of global output) was also farmed, and was very successful in the early 1990's in China.

During the 1990's, problems with farming – disease in particular, usually linked to over-intensive production - stalled growth. By the mid 1990's, growth in production slowed, with farmed shrimp accounting for a steady 22-25% of overall supplies. Average growth measured about 3% p.a. for the decade due to a slight upturn at the end of the 1990's; however, a significant change occurred in year 2000 (see Table 3). While fisheries' output seemed to remain static, farm production in Asia, predominantly in China, grew rapidly, reaching 1.3 million tons by 2001 – a growth rate of 22% per annum. Industry sources (e.g. the GAA - Global Aquaculture Alliance) believe that output will approach 2 million tons by 2005.

Table 3: Global shrimp production by fishing and farming (unit '000 tons)

	Fisheries	Farming			Total	Farmed %	% Increase in Total Production
1975	1,331	13			1,381	1%	
1980	1,570	75			1,645	5%	19%
1885	1,855	200			2,055	10%	25%
1990	2,001	633			2,634	24%	28%
1991	2,146	690			2,836	24%	8%
1992	2,230	721			2,951	24%	4%
1993	2,311	609	S America	SE Asia	2,920	21%	-1%
1994	2,385	733			3,118	24%	7%
1995	2,440	712	154	558	3,152	23%	1%
1996	2,554	693	172	521	3,247	21%	3%
1997	2,629	660	198	462	3,289	20%	1%
1998	2,749	813	226	587	3,562	23%	8%
1999	3,034	845	172	673	3,879	22%	9%
2000	3,081	1,098	160	938	4,179	26%	8%
2001	2,873	1,236	136	1,100	4,109	30%	-2%

Sources: FAO/World Shrimp Farming, LMR Fisheries Research (Annex I)

Figures from Table 3 indicate overall international shrimp production has grown at an average of 5%, with substantial increases between 1998 and 2000.

B.3. Environmental Implications of Shrimp Farming

As stated above, shrimp farming has serious negative impacts on the environment and the critical stages at which this occurs are during construction and management.

The Mangrove Issue

Much mangrove was lost to shrimp farming in the industry's early days, as producers sought to use this ecosystem because it provided the right conditions (i.e. flat low-lying land close to brackish water) and was perceived to have low economic value. Although it is now claimed (e.g. by the GAA) that losses were exaggerated and obscured for other reasons (e.g. rice culture, wood harvesting). The loss of the mangroves supposedly resulted in reduction of mangrove forest by 1 million hectares according to some activists. However, as this is also approximately the total area under cultivation (1.3mha), and as development also used non-mangrove areas to a large extent, this looks like a significant overestimate. In addition to these environmental issues, mangrove areas are ill-suited for shrimp farming for four reasons: (a) they are inter-tidal, so ponds constructed in this zone cannot be drained easily, causing problems with maintenance, husbandry and harvest. This is limiting for semi-intensive culture. (b) Mangrove areas are very expensive to clear and construct in because of the strength of mangrove root systems and (c) when ponds have

been built, the residue of mangrove roots in the soil decomposes and the resulting humic acid lowers the pH to levels that impede shrimp growth. This was a serious problem for some pioneer projects. Finally, (d) storm surges pushed by strong onshore winds can devastate pond banks and/or levees, and the best protection against this is a mangrove barrier to attenuate the high waves. Indeed extensive mangrove replanting has occurred in some areas to reinstate the mangrove belt as protection. Farmers should concentrate their efforts on mudflats behind the mangrove belt where these exist, or on marginal coastal agricultural land. Key factors to consider are the substrate (clay) and slope and height above sea level.

Management

More recently, production has become more intensive. This more industrialized process involves the manual stocking of ponds with either wild caught or hatchery produced “post-larvae”. Stocking rates are 100 times greater than the lower yield sustainable systems. Ponds are “fertilized” with urea and phosphate to stimulate algal growth, on which the shrimp feed. Increasingly, supplementary foods are used. To maintain oxygen levels, ponds must be frequently flushed, involving pumping the polluted effluent. This effluent can easily contaminate lands and coastal waters. By controlling the development of farms, carefully siting effluent channels and building in settling tanks, which should be cleared regularly, effluent pollution would be minimized.

B.4. Market

There are two principal markets for shrimp - international and domestic (see Table 4). Approximately half of the global shrimp supply is traded, with the OECD very much the major consumer. Within the OECD, the USA is the largest importer, followed by Europe and Japan. The other half is consumed where produced, in domestic markets, and generally comprises smaller shrimp of less favored species.

Table 4: Estimate of the main OECD supplies of shrimp
Round (live) weight, including imports and domestic landings

	USA (tons)	Europe (EU) (tons)	Japan (tons)	Total (tons)	% Increase in Supplies
2000	706,950	541,836	379,400	1,628,168	
2001	788,600	534,206	379,900	1,699,707	4%
2002*	888,106	535,176	378,700	1,801,923	6%

Source: see Table II.2, Annex II. * Projections based on trend analysis

In the USA, shrimp competes with tuna as the most popular seafood. Shrimp and prawn sales are particularly made through restaurant trades such as Red Lobster, Bubba Gump, Shoneys, Long John Silvers and Sizzler. Red Lobster alone sells almost 5% of the total world production of farmed shrimp and its advertising is thought to be largely responsible for the 250% increase in shrimp consumption in the United States. Shrimp is an important ingredient in ready-made meals, with peeled frozen prawns in high demand.

It is projected that demand for shrimp will grow significantly in the American market, supported

by advertising and promotion. Furthermore, recently reduced prices have helped to stimulate demand. Due to disease problems in Ecuador and constraints on the supply of captured shrimp, China and Southeast Asia have greatly increased their production of tropical farmed shrimp resulting in oversupply at the present.

B.4.a. Buyers

As mentioned above, USA and European consumption has grown, but at the expense of the recession-dampened Japanese market, which has been in retreat (see Table 5).

Table 5: The main OECD markets for shrimp imports – 1999-2000

	USA imports	Europe (EU) imports	Japan imports	Total imports
1998	316,000	363,144	238,900	918,044
1999	331,700	348,034	247,300	927,034
2000	345,100	378,375	246,600	970,075
2001	400,300	363,184	245,000	1,008,484
Growth				
5yr avg	+6.4% pa	+2.8%pa	-1.7%pa	+2.8%pa
10 yr avg	+5.0%pa	+2.9%pa	-1.5%pa	+2.3%pa

Sources: Globefish/NMFS/Infofish (See Annex II)

The USA can be considered a booming market with an increase of 5%, followed by Europe. Surprisingly, including Japan's stagnant growth, the overall market is growing at over 2% pa, which is very impressive.

B.4.b. Characteristics

The markets differ considerably, and can be characterized as follows (see Table 6):

Table 6: Characteristics of OECD shrimp trade

Country	Value	Proportion of main shrimp groups in national imports			Preferred product
		White	Black tiger	Cold water	
USA	3.6	26%	72%	2%	Frozen shell-on tails (51%) Peeled tails (31%)
Japan	2.3	7%	80%	13%	Frozen shell on tails
Europe	1.9	34%	33%	33%	Various - see Table 7

Sources: Globefish/NMFS/Infofish

- **USA is a commodity market** where over 80% of imports are shrimp tails, shell-on or peeled, the balance being added value – i.e., peeled, breaded, in recipe meals, etc. Whole shrimp plays a very small part in this market, and a former preference for white shrimp (the

species produced in the USA) has reversed to favor black tiger. Major suppliers are Mexico, Ecuador and China for white shrimp and Thailand, India, Vietnam and Indonesia for black tiger.

- **Japan is also a commodity market**, albeit one with high quality and specification expectations. Japan sources very widely – including 90 tons from Nigeria last year and 4,000 tons from other African sources (Madagascar and Mozambique), but the main suppliers are Indonesia, India, Vietnam, Thailand and China.
- **Europe is not a commodity market** – it is complex and diverse with different EU states having completely different preferences and sourcing patterns. Trade data is less specific than for other OECD markets and often overstated, as internal imports are added erroneously to the total (these are internal re-exports). An indication of this diversity is given in Table 7.

Table 7: European Country Details (frozen shrimp imports)

Country	Proportion of all EU imports	Proportion of white shrimp in national imports	Preferred product
Spain	31%	93%	Whole shrimp
France	20%	49%	Whole shrimp*
UK	12%	86%	Small peeled tails
Netherlands	11%	43%	Tails
Italy	10%	48%	Whole shrimp
Other EU	17%	31%	Various

*Particularly from its francophone African partners
Sources: Globefish/NMFS/Infofish

B.4.c. Buying Criteria

Shrimp has become a commodity, albeit one that is complex and diverse. Global trading reflects this, and indeed commodity markets now quote futures (e.g. the white shrimp contract on the Minneapolis Grain Exchange). This means that there is some clarity in global pricing, but it does not reduce the complexity of shrimp marketing - complexity that arises for a number of reasons discussed below. However, what is particularly important is that price differentials between different segments can be very high – even when the segments are seemingly similar. Key issues include:

- **Quality:** critical with any seafood and especially for crustaceans given the health risk. Shrimp that are less top quality are then heavily discounted and tend to be sold through specialized markets (Dutch especially) able to deal with debased product.
- **Different shrimp species** trade into different markets: northern pandalids, tropical white (*Penaeus vannamei* mostly), pink and brown penaeids and black tiger (*P. monodon*) all have distinct market niches, as do scarcer specialized species (e.g. the Netherlands and UK's small gray shrimp used in potted shrimp). The white shrimp category is dominated by *P. vannamei*

from Latin America, but also includes P. chinensis, formerly the main Chinese farmed shrimp, and some P. indicus farmed in India and the Middle East. This has been the preferred category in some markets, but this is now changing.

- **Product form:** there are three main categories with different markets:
 - **Whole (head-on) shrimp:** a premium product, especially sought after in Mediterranean countries - Spain particularly for white shrimp. Globally, large black tiger and freshwater prawns are in demand as a “display” product.
 - **Tails (head-off, headless),** with the head removed but shell left on: the standard commodity penaeid marine shrimp product.
 - **Peeled, PUD, PD** - peeled tails, either “de-veined” or not, depending upon whether the dark gut (vein) has been removed or not: mostly small shrimp, usually from low-cost labor areas, although this is also the favored form for pandalids caught by commercial North Atlantic fleets which have sophisticated peeling machinery.
- **Preservation method: fresh, frozen raw or semi processed or fully processed** (i.e. as breaded shrimp). The great bulk of internationally traded shrimp are sold frozen, graded, as whole or tails with fully processed tails representing the balance (e.g. 1998 USA imports were 86% frozen (tails and whole) and 13% processed). There is some trade in dried and smoked shrimp to ethnic markets.

The issue that has most impact upon the price that farmed shrimp achieves is **size grade** - the larger the shrimp, the better the price, by a substantial margin. Shrimp are graded by “count”, i.e. the number per pound (for tails) or kilogram (for whole shrimp) (see Table 8). The important point here is the significant price differential between grades - on average 15-18% per size grade. This obviously has a major impact upon revenues, and all shrimp farmers juggle the trade-off between maximizing revenues by going for maximum growth, versus limiting costs by harvesting smaller shrimp earlier.

Table 8: The size grade price relationship for shrimp whole and tails*

Tail count /1b	Whole count /Kg	Avg Weight/whole Shrimp	Price /kg \$US White Shrimp US Market***	Differential White Shrimp US Market
16 –20	20 – 29	41gm	15.1	21%**
21 – 25	30 – 35	32gm	12.5	17%
26 – 30	36 – 40	26gm	10.8	15%
31 – 35	41 – 49	22gm	9.4	22%
36 –40	50 –55	19gm	7.9	9%
41 – 50	56 – 70	16gm	7.1	24%
51 – 60	71 – 85	13gm	5.7	18%
61 and above	85 – 110	10gm	4.8	

* CIF OECD markets, 5 year average 2002, shell-on tail yield assumed to be 62.5%

** difference between this grade and the grade below

*** averages 1997-2002

B.4.d. Packaging

Whether whole or tails, shrimp are normally packed in 1 or 2kg waxed boxes (usually of attractive “retail” standard, well labeled) with thin plastic separators. The boxes are in turn packed in strong 18 to 24kg master cartons, and then shipped by 40 ft (18ton) container. Trade formerly involved agents who did not take title to the goods, but charged around 2% for handling and arranging distribution. Latterly, direct links between producers and OECD buyers/users have streamlined this. Indeed, the role of the broker in handling sales in the user market has declined as processors and retail chains buy direct from trusted suppliers in the producer countries.

B.5. International Shrimp/Prawn Prices

After a long period of relative stability, prices started to fall during 2000 and have continued to decline in 2002. This happened across the board, although the decline was not necessarily even. Key shrimp category prices show an average annual decline of 5 to 8% over these two years. At the same time, the premium that white shrimp tended to get over black tiger has reduced to marginal levels, while size grade differentials have increased, especially at the expense of smaller grades. Taken together, this suggests that the comparative market advantage that white shrimp once had has eroded. Although the Spanish whole shrimp market (which gets premium prices) still favors white shrimp, this is now countered by a French preference for whole darker shrimp i.e. black tiger, or darker strains of P. vannamei.

The reasons for the overall price decline are probably complex. Firstly there was the rapid increase in farmed shrimp output post 2000 (60% plus). This was targeted at OECD markets and so affected international commodity prices in particular (wild shrimp production also increased, but this was mostly “akiami” shrimp from China which sells to an entirely different market). Secondly there has been the faltering global economic position since the technology bubble collapsed. As Japan has demonstrated, shrimp is a luxury that suffers in times of economic

decline, and this may explain recent static demand in Europe as well as Japan. Conversely, consumption in the USA increased, but perhaps indicative of a more flexible market responding to the large price decline, reinforced by significant advertising and promotion.

Table 9: Price-time sequences for key shrimp/prawn indicator products, 1997-2002

	1997	1998	1999	2000	2001	2002
Average price white shrimp Tails, port landed USA: \$US/kg	12.4	11.9	11.2	13.7	12.5	7.5
Black tiger 26/30 grade Tails, CIF USA: \$US/kg	13.3	13.7	11.6	13.8	11.0	10.0
White shrimp 26/30 grade Tails, CIF USA: \$US/kg	15.4	14.9	13.2	14.0	13.3	10.7
Freshwater prawns 20/25grade Tails, CIF EU: \$US/kg	11.8	12.5	10.4	11.4	7.9	5.8

Source: Price data from US NMFS, FAO Infofish (see Annex III)

B.6. The Market for Freshwater Prawns

Production

Global production of freshwater prawns (*Macrobrachium* sp.) has been informally estimated as 150,000 tons in 2001, worth about \$1billion (5% of the total shrimp market). This is up from 130,000 tons in 1998. What is unclear, though, is how much of this is farmed and how much produced by wild fisheries. This distinction is often blurred, especially in Southeast Asia, where the line between augmented fisheries and extensive culture can be very vague. China is the leading producer, with Bangladesh the other main player, while India is becoming a growing force in the industry. Thailand and Taiwan, early pioneers in prawn culture, have latterly become minor players. Vietnam is developing a prawn culture industry based upon prawn/rice poly-culture, and rapid increases in production in the Indian subcontinent are thought to arise from the incremental addition of prawn poly-culture to a large existing carp farming industry. This allows rapid expansion at very low investment cost.

Trade data mostly does not distinguish between *Macrobrachium* and other tropical prawns, and so trade flows are hard to gauge. Informally, traders estimate that monthly freshwater prawn imports by the main EU processors are 20-30 containers (20t/40ft) amounting to 6,000 tons per year. The main UK processor imports around 600 tons annually. Overall imports are probably significantly larger than this, as much trade bypasses the large processors (the ethnic and restaurant trade is seen as a lower key, parallel business by the big processors). That said, the freshwater prawn trade is clearly only a fraction of that for penaeid shrimp. For example, the specialized niche market for large prawns for display in restaurants/fishmongers is very small – a leading UK trader would expect to sell a few tons annually.

Table 10: Freshwater prawn production in 1998

Country	Tons	Share
China	62,000*	45%
Bangladesh	48,000	35%
India	12,000	9%
Thailand	8,000	6%
Taiwan	7,800	6%
Total	137,800	

Sources: Roseberry World Shrimp Farming and interviews with traders

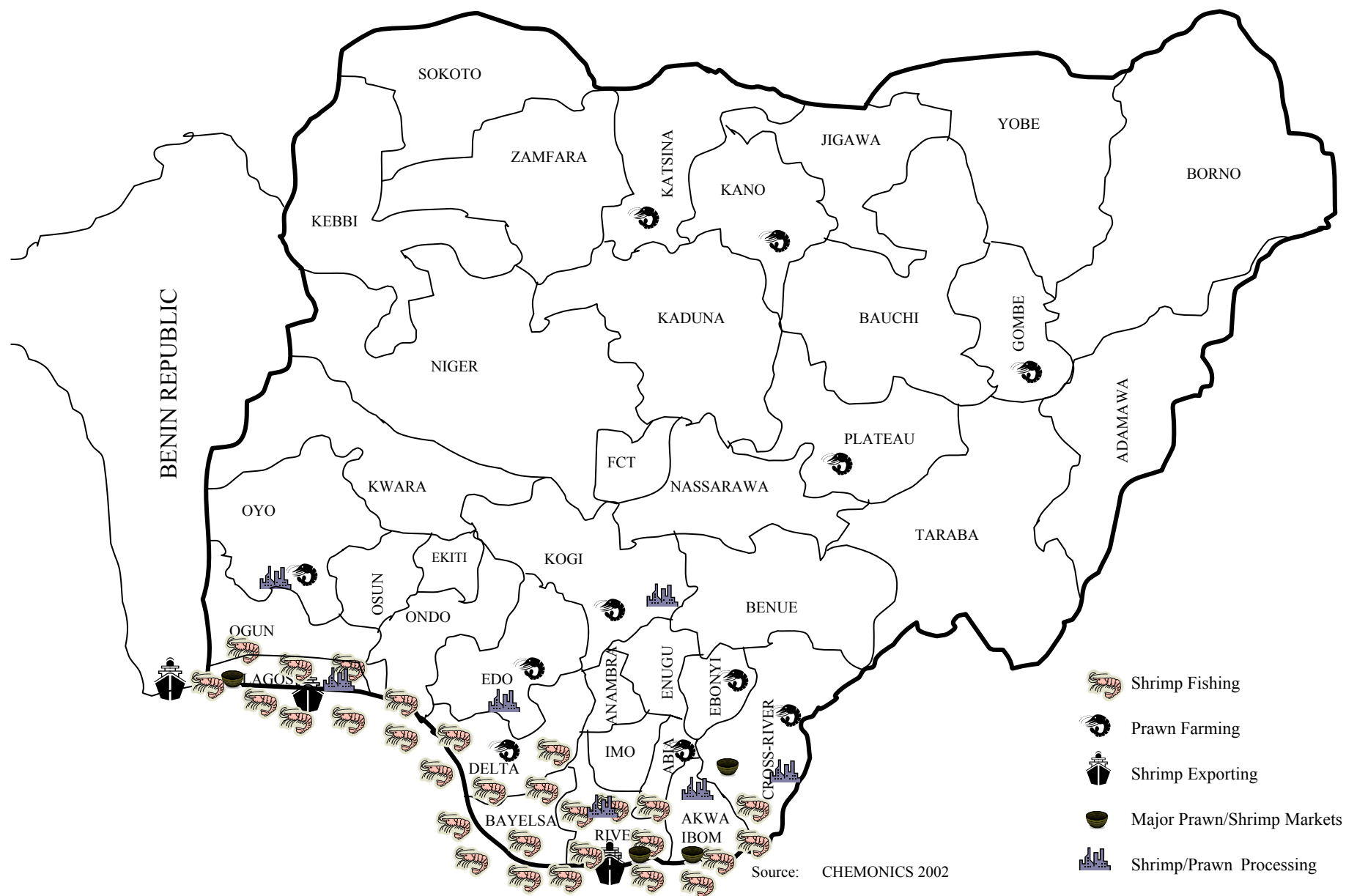
* China claims 100,000 tons is farmed, but production there has in the past been overstated

The point is made above that shrimp is a commodity, albeit with diverse segmentation, and one such segment is the freshwater prawns market. This means that, on the one hand, they follow the broad commodity trends in the market (i.e. have mirrored price declines shown by other shrimp products), and are also subject to a similar grade system with sharp size-dependent price differentials.

On the other hand, prawns reach a specialized market that is related to the traditions of ethnic groups within OECD markets - particularly Asiatic communities for whom freshwater prawns have been important in their national diets. This means that ethnic markets - and their restaurant trades - particularly favor prawns. They also have a specialty niche in the wider market – prawn's large size and impressive appearance makes them an attractive “feature” item for displays by fishmongers and up-market restaurants.

Another facet of this distinction is the significant discount that freshwater prawn tails suffer on international bulk markets (formerly 20%, relative to black tiger tails of the same size grade). This has increased dramatically (to 50%), and so it appears that prawns have suffered disproportionately from the recent market downturn. In view of the poor tail meat yield from freshwater prawns (40% rather than 60% plus for black tiger) this means that live freshwater prawns are now less than a third of the value of the equivalent weight of black tiger.

Figure 4: Map of Nigeria Showing Shrimp/Prawn Activity Areas



II. THE NIGERIAN SHRIMP AND PRAWN INDUSTRY

Nigeria has both a marine shrimp and freshwater industry. They are very distinct and will be treated separately in this section.

A. Nigerian Marine Shrimp Industry

Nigeria already has a shrimp industry –based on capture not culture. Nigeria lands around 250-350,000 tons of fish annually, of which about 55% is marine fish, with the balance fresh water fish. Imports of 550,000 tons of fish complete the supply picture. The implications of this shrimp fishery for a possible farming sector are significant: (i) it demonstrates proven capacity to process and export shrimp (ii) there is an established Nigerian position in the international shrimp marketplace, and (iii) it provides a production cost base against which the economics of farming can be compared.

A.1. Background

Shrimping in Nigeria dates back to about 1950. Then, the exploitation of Nigerian shrimp resources was handled by foreign fishing vessels. By 1961, there was a large commercial stock of shrimp in the Nigerian territorial waters to sustain a shrimp trawling industry. Prior to the discovery of shrimp in commercial quantity, the focus of trawlers brought in from Greece, Spain, Italy, Japan and America was finfish with shrimp featuring as a by-catch.

During this period, the Nigerian Naira was strong (about N1 to \$1 U.S.) and fish landed and sold locally was very profitable. By 1986, the Naira devalued as a result of Structural Adjustment, and fish sold locally could not meet operational cost and the appetite for foreign exchange increased. Shrimp, which used to be a by-catch became the focus because of its high export earnings.

A.2. Production Areas

The Nigerian commercial shrimping ground lies east of longitude 5 degrees east to the Nigerian/Cameroon border, principally in the Niger Delta and off river mouths, in estuaries and lagoon with soft mud deposits. Marine shrimp are caught by artisan and industrial trawlers. The artisan fishermen shrimp between 0 to 5 nautical miles along the continental shelf while the trawlers, supposedly, fish from 5 nautical miles and beyond. Typical shrimping areas are Escravos, Forcados, Ramos, Penninton, Brass, Bartholomew, Calabar (see Figure 4), along the Nigerian continental shelf.

A.3. Shrimp Species

The most sought after shrimp in the Nigerian shore is Penaeus notialis, the white shrimp. Other shrimps of commercial importance are listed in Table 11.

Table 11: Shrimp resources of the Nigerian continental shelf

S.N.	SCIENTIFIC NAME	COMMON NAME	REMARKS
i.	<i>Penaeus notialis</i>	White Shrimp	Occurs in depth of 27-45m
ii.	<i>Parapenaeopsis atlantica</i>	Brown Shrimp	Depth of 9-27m
iii.	<i>Parapenaeus longirostris</i>	Red Shrimp	Depth of 150 -200m
iv.	<i>Penaeus kerathurus</i>	Stripe or zebra Shrimp	
v.	<i>Palamonidae, Nematopalaemon hastatus</i>	Estuarine prawn	Exploited in the shallow areas by the artisan fishermen.

A.3.a. New Species - *Penaeus monodon*

An important and interesting feature of late has been the arrival of wild *Penaeus monodon* specimens in trawler catches. *Penaeus monodon* (Tiger shrimp) appeared 4 years ago, and apparently occurs mainly in the Calabar/eastern delta zone where it comprises as much as 10% of trawler catches. This is an Asiatic exotic that could have only arrived by man's agency (African current patterns preclude natural introduction), and presumably escaped from a West African (Gambian, Senegalese or Cameroon) shrimp farm.

This is important for shrimp farming for two reasons: (i) firstly because it forestalls the question of introduction of an exotic farm species to an existing economically important shrimp ecosystem - obviously, *P. monodon* is already in Nigerian waters. (ii) Hatcheries, that are essential for commercial shrimp culture, still mostly depend upon wild caught gravid (egg bearing) females for a source of eggs. This is particularly true for *P. monodon*, and so the presence of a viable population in Nigerian waters assures a local supply of these gravid females.

A.4. Season

The shrimping season in Nigeria runs between May and October, a period when *P. notialis* (white shrimp) is in abundance. As from November and April the brown shrimp predominates but occurs in shallower water.

B. Nigerian Shrimp Production

Nigeria has an important shrimp trawling industry, catching white shrimp (*Penaeus notialis*) and some brown shrimp (*Metapenaeus* sp). Reliable production data is scarce but historic data shows reported landings of 10,000 to 15,000 tons annually, though anecdotal reports mention 30,000 tons (as do some landings statistics that cover the 1980's). Discrepancies are usually accounted for by illegal at-sea sales that go unreported. OECD trade data provides an alternative measure - some 6,800 tons were imported into Europe in 1998 (which takes the great bulk of Nigerian shrimp). Adjusted for weight loss on processing, this equates to 10,000 tons, live weight equivalent, and so there is some corroboration for a figure of this magnitude.

Table 12: Nigerian shrimp landings (Units: tons'000's live weight)

Year	White shrimp	Other shrimp	Total
1990	8,611	1,600	10,211
1991	9,324	2,980	12,304
1992	11,944	1,557	13,501
1993	13,755	2,612	16,367
1994	8,595	2,207	10,802
1995*	12,250	-	
1996	9,550	-	
1997	10,810	-	
1998	10,720	-	
1999	15,250	-	
2000	8,060	-	

*1995 onwards – “white shrimp” includes all species
Source: FAO and Federal Ministry of Agriculture

The CIF Europe value of this export is approximately \$US 60 million annually.

B.1. Structure of the Industry

Trawling

Data on the shrimp industry is limited, but its main parameters are clear. The industry is based in Lagos, while fishing occurs in the Delta-Calabar region some 500 to 650 km to the East. The base unit of the industry is the freezer trawler – typically a 22-25m vessel with an onboard freezer (blast or plate freezer) and cold store capable of maintaining product at -18°C to -20°C. Trawling involves towing a net along the seabed, the mouth of which is held open by a beam or vanes (trawl doors), and is most productive at night when the shrimp are more active. The capacity for freezing on board is critical, especially as the fishing grounds are so distant from the shore facilities in Lagos: this is a key determinant of product quality because shrimp can be frozen almost immediate after capture. The trawlers catch fish along with shrimp as “by-catch”, but most of this is discarded or sold to small local craft that come out to the fleet. The exception is tongue sole (*Cynoglossus*), a valuable species processed by the companies (annual output – around 4,000 tons).

The companies and fleet

There are some 36 companies, nearly all based in Lagos. A list of the companies believed to be most active is given in Annex IV and of these, 17 have significant operations (see Table 13).

Table 13: The Nigerian Shrimp Trawling Industry

Company	Active fleet Freezer trawlers	Capacity	Location	Foreign Partner (if any)
Savannah Group				
ICF	12		Apapa, Lagos	Indian/Dutch
Primlaks	11		Benin City, Edo	"
Atlantic shrimpers	9	120 tons	Surulere	"
Intra Fisheries Co	6	"	Isolo, Lagos	"
Universal Associates	4	"	Ijora Causeway, Lagos	"
Universal Fishing	3	"	Isolo, Lagos	"
Paramount Frozen Foods	3	"	Badagri Road, Lagos	"
Nigerian Fishing Net	2	"	Badagri Road, Lagos	"
Cosmos	2	"	Victoria Island, Lagos	"
Savannah	3	50 tons	Victoria Island, Lagos	"
Sub-total	55			
Ocean Fisheries	18	6,000 tons	Apapa, Lagos	Indian
ORC	11	1,000 tons	Ebute Metta	"
Obelawo Farcha Industries	18	N/A	Apapa, Lagos	none
Dolphine Fisheries	12	1,500 tons	Tin Can Island, Lagos	Chinese
Tarabaroz Fisheries	11	100 tons	Tin Can Island, Lagos	Russian
Banarly/Olokun	10	1,250 tons	Ebute Metta, Lagos	Indian
Honeywell	9	uses Banarly's	Victoria Island, Lagos	none
Benguela Fishing Industries	2	-	Kirikiri	none
Sub-total	146			
Others (17 companies)	15			
Total	161	10,000 tons		
Other companies				
United Fisheries	Trader			

However, one group has come to dominate – the Savannah group, which comprises at least 10 companies and owns between 30 and 40% of the active fleet. Altogether 244 vessels have been registered, but only 180 of these are deemed to be operational (NITOA, the Nigerian Trawler Owners Association, believes that the actual figure is 153 now). The ownership of these companies is obscure, but the resident Indian community is clearly significantly involved in both ownership and managerial roles. Vessels catch 6 to 7 tons of shrimp per month at sea, producing around 60 tons annually (allowing for down time, etc). If the fleet does indeed comprise around

150 active vessels, then this is consistent with annual production of 9-10,000 tons, a figure that accords with data from trade sources.

It is clear that the industry has been undergoing rationalization and fleet reduction over the last 5 to 10 years. This has been brought about by maturity in the fishery (with catch rates declining from earlier “new fishery” levels) and economically unsustainable levels of fishing (catch rates are low at around 200kg per day). The decreasing international prices have also helped accelerate this reduction. Problems with the high cost of fuel (no concessions are given to the commercial fishing industry) are mentioned by the industry, as is a serious problem with piracy in the Delta region (31 incidents were recorded during 1999, with theft mostly the motive, although hostage taking also occurred. The western Delta region was the principal offender).

Processing

Most Nigerian shrimp is frozen whole at sea, and can be packed there and then as a finished product for the “head-on” whole shrimp market (plate frozen in 2kg boxes). The main role of the shore facilities in Lagos is to store and aggregate the frozen landed product prior to export by 40ft (18 ton) container. Alternatively, bulk (blast) frozen shrimp can be further processed in the Lagos plants –the shrimp are thawed, de-headed and can either be packed as such or peeled (as PUD or PandD product). The trend in the market is towards requiring increased added value and so further processing may become a more important activity in Nigeria. The shore facilities in Lagos then are typified by large cold stores and vessel maintenance facilities, located on the shore close to the port in Apapa, Tin Can Island, etc. In some cases, the shore bases have processing lines and plate freezers, and these provide the added value.

Certification

Latterly, achieving the sanitary standards now demanded by OECD markets has become a key issue. These require the introduction of product safety systems (e.g. HACCP-Hazard Analysis at Critical Control Points) and the replacing of the testing of product at borders with national certification systems. These national systems incorporate a Competent Authority (a central point of responsibility), a national reference testing laboratory and an effective inspectorate. Nigeria established this system in 1998 and has been rewarded by inclusion on the EU “Decision 2001/635/EC - Part 1” list of countries – so is able to export freely to the EU (and thus, in effect, the OECD).

The Federal Department of Fisheries (FDF) is designated as the competent authority in Nigeria, but practical supervision has, in the interim, been devolved to the National Agency for Food and Drug Administration and Control (NAFDAC) who are currently better equipped for the role. This confusing situation will need resolution – processing plants and freezer trawlers have been given both FDF and NAFDAC certification numbers and this needs streamlining.

Current data is scarce, but there are apparently four certified processing plants (although there are other potentially operable plants, currently dormant for lack of raw material supplies). These are all owned by fishing companies, and the fleet owners also have 7 cold stores with a reported combined capacity of 10,000 tons (although much of this is no doubt used for purposes other than shrimp storage).

Nigeria benefited from the fact that most shrimp is frozen at sea (so removing much of the health risk) but the fact that the processors apparently jointly helped fund the testing laboratory demonstrates enlightened cooperation and commitment to the industry. The processing plant visited (Banarly/Olokun) was impressive and reinforced the impression that Nigeria can provide more than adequate processing capacity for a sizable export-oriented shrimp culture industry.

B.2. Production economics

Trawling

Shrimp trawling has prospered in Nigeria as it was both profitable and generated foreign exchange. As Table 14 shows, unit production costs are nearly \$5/kg whole shrimp, which equates to \$7.8-\$8 per kg of tails (allowing for processing weight loss). While prawn tail prices averaged \$10/kg, the business was clearly profitable, generating margins of 30%. Now it must be close to breakeven at best, and the exit of many players from the industry indeed suggests that this is the case, as did discussions with trawler managers.

Table 14: Nigeria shrimp trawler production costs estimate

TYPES OF COST	AMOUNT (US \$)
Capital related costs (annually)	109,000
Operating costs	
Fuel (1.25 tons/day @ \$230/ton for 275 days year)	79,000
Labor (12 crew @ \$2,000 pa)	24,000
Maintenance and spares (say 3% of capital value)	22,500
Overhead and management	22,000
Total	256,000
Unit production cost (based on annual catch of 60tons)	\$4.30/kg
Packaging and freight costs	\$0.60/kg
CIF EU unit cost	\$4.90/kg

Source: Model in Annex IV, based on data given by NITOA and company managers interviewed

Economic revival will depend upon either prices rising or catch rates improving, as there is little scope to reduce costs. If prices don't rebound, then the principal option facing the industry must be to reduce overall capacity to allow unit catch rates to increase for the remaining vessels, a situation that may be faced by much of the world's shrimp fisheries. This is already happening with the Nigerian fleet – and an indication of the eventual impact on the fleet if prices remain at current levels can be estimated as follows: to restore profitability, catch rates would need to increase by 50% (i.e. from 60 to 90 tons per boat per year). This would imply a fleet reduction of at least 35% (i.e. reducing the fleet to around 100-110 boats).

Processing

Unit shrimp processing costs for Nigerian plants were also estimated. The processing in question is producing headless, or more probably, peeled tails (PUD or PandD), because the most basic

form of processing – freezing and packing whole – is carried out at sea (and is part of the trawlers production cost). As Annex IV shows, production costs are estimated as \$0.76 per kg of raw shrimp (alternatively, equivalent to \$1.7/kg of peeled tails) with a further \$0.16 per kg for packing materials. There is scope for contract-processing of farmed shrimp – provided it can be done in Lagos and the raw material is maintained in good condition. The estimated costs of simply beheading and packing are about half those for peeled tails – say \$0.35 per kg of raw material.

However, the fact that the only practical way of delivering farmed shrimp to the Lagos plants will be as already frozen product means that there will be little benefit in this approach – i.e. the shrimp might as well be processed when first frozen near the farm. This option is then only relevant if a farm were to be located near Lagos or if added value processing (e.g. as PUD or PandD) is worthwhile. The obvious implication is that a shrimp farming industry will need to set up its own processing facilities near to its on-growing facilities. A possible “halfway house” during early stages of the industry would be leasing of one of the more time-expired (and less efficient) freezer trawlers and moor it near the farm as a standby processing facility (i.e. using just its cold store and freezer unit). If the arguments in the preceding section prove to be prescient, then there could be quite a range of vessels to choose from.

C. The Nigerian Freshwater Prawn Industry

Background

Prawns are entirely fished from the wild and harvested as far inland as 250km in the various river systems and lakes mainly in the southern part of Nigeria. A few species such as *Atya garbonensis* occur inland around the Middle-Belt areas especially Makurdi. They are fished using mainly fishing traps, which are usually baited with fish, coconut, cassava, onions and palm-kernel nuts. To a lesser extent, they are caught in cast and gill nets as incidentals while targeting some other fin fishes. During the breeding season (at peak of rainfall) some of the species, particularly the African River Prawn, migrates to the brackish waters perhaps to breed. At this time it is caught with *M. macrobrachi* though relatively in fewer quantity.

Production Area

Production areas are restricted to the inland fresh waters such as Epe and Lagos, Lagos State; Asejire, Oyo State; Port Harcourt, Rivers State; Calabar, Cross-River State; and Lokoja, Niger State (see Figure 4). Records of production are not available.

Local Species

The locally occurring freshwater prawn of economic importance in Nigeria is Macrobrachium vollenhovenii (African River Prawn). A second one of less importance is M. Macrobrachion, which occurs in brackish waters in Badagry, Lagos State; Port-Harcourt, River State; and Calabar areas, Cross-River State. Other species of less economic importance are *M. felicinum* (Niger River Prawn), which is found around the Niger-Delta areas, and *Atya garbonensis* found around the Middle-Belt areas (see Table 15).

Figure 5: A Basket of local prawns species on display at a local market



Table 15: Local Species of Freshwater Prawns

Scientific Names	Common Names	Remarks
<i>Macrobrachium vollenhovenii</i>	African River Prawn	Found in fresh waters and of high economic importance
<i>Macrobrachium macrobrachion</i>	Brackish Water Prawn	Occurs in Brackish Water
<i>Macrobrachium felicinum</i>	Niger River Prawn	Found in Brackish Water around the Niger Delta area
<i>Atya garbonensis</i>		Located in Middle Belt

Seasons

The peak of their occurrence is during the rainy season (May to September), when they are harvested by local fishermen using non-return valve traps.

C.1 Aquaculture of Freshwater Prawns

Commercial Culture

Apart from a few artisan producers, fresh water prawns are not currently cultured in Nigeria, in spite of considerable interest in the prospect. The idea of culture dates back to about 1986 when the Federal Government took interest in the World Bank assisted Agricultural Development Project (ADP). Following report on the viability of culture by the then Federal Agriculture Coordinating Unit, a pilot project was initiated in Epe, Lagos State by the Lagos State ADP. Production ponds and a hatchery complex were constructed and some officers of the ADP were sent to Puerto Rico to master the technique of larvae production using *M. rosenbergii*, which is a close relative of the indigenous species (*M. vollenhovenii*). Post-larvae were equally collected from the wild and tried out. About the same time, the saline relative, *P. notialis* was being tried out in the River State ADP. Both projects have since been abandoned because of poor funding, inability to master the technique of larvae production and inconsistency in Government policies.

Currently, Shell Oil Company, as part of their community support program has built trial prawn rearing ponds at Iriebe near Port Harcourt. This project is due to start operating later this year, and a key issue is the choice of species to culture (Shell originally wished to import an exotic, M rosenbergii from US stock, rather than try local species, but are apparently now considering M vollenhovenii as well). AGIP has a similar project near Brass in mid Delta. These projects highlight two critical issues: which species to culture, and the devising of technology for doing so economically in Nigeria (particularly for hatcheries):

(i) **Choice of species:** there is a local species which grows to a large size (100gm plus) *Macrobrachium vollenhovenii* and would seemingly make a good candidate for culture as it apparently grows relatively rapidly, and obviously well adapted to Nigerian conditions. Moreover, using this species would avoid the risk of introducing an exotic like *M. rosenbergii* (and, in particular, risk of disease which has proven to be a critical constraint on shrimp culture). It would also provide opportunities for using wild postlarvae with benefits for security of supply of larvae and jobs for those fishing for these larvae.

(ii) **Culture technology:** the main reason why *M vollenhovenii* cannot be farmed at present is failure, as yet, to produce postlarvae artificially. It is unclear whether this is a fundamental problem, or one of insufficient research, but what is certain is that this issue must be resolved before culture of this species can be considered as a commercial option.

Artisanal Culture

Artisanal prawn farming as is currently being undertaken in Nigeria is typified by a 0.25 hectare, 10 pond farm at Ikot Abasi near Calabar. This relies on wild post larvae to produce prawns in polyculture with tilapia. As there is minimal feeding, it is an extensive system, producing of the order of 800kg per hectare. Prawn prices are low around Calabar, but even so, the results pleased the farmer, providing an encouraging precedent for small-scale prawn culture in Nigeria.



Figure 6: *Prawn Harvesting at a Demonstration Pond in Lagos State*

The practice of some form of prawn farming was also observed in Epe, Ikot-Abasi and Eket. It indicates a willingness to go into prawn farming. Addition of prawn farming to the existing fish farm would increase rural income and generate employment.

Aquaculture-Catfish

Catfish (*Clarias* and *Heterobranchus*) are the principal species cultured in Nigeria – for good market reasons (see Table 16). Furthermore, catfish are highly resilient, able to survive poor water quality and being transported live to market. As a smoked product they are a Nigerian favorite. Indicative costs for a semi-intensive catfish farm are used as a benchmark as they set the standard that prawn culture would need to meet to attract investors. These suggest that catfish farming is reasonably profitable, with a small commercial unit able to generate net revenues of \$US 3,500 (N455,000) annually if well run.

This is a mid level operation, and there are both smaller scale and larger, more intensive alternatives. At the smaller scale, extensive units (family ponds) covering perhaps 0.05-0.1 ha and relying upon waste products for feed (e.g. palm kernel meal, celerac waste at \$80/ton delivered) would generate family income of around \$1,000 (N130,000) annually. The risks faced by these pond-based operations include problems with hatcheries, obtaining fingerlings, security (requiring guards and fencing), but the most damaging factor reported in the Rivers State was flood, which had caused two massive losses during the last 10 years.

Table 16: Operating economics of a Nigerian catfish farm

One hectare, 10 pond farm growing *Clarias* semi intensively
(with feeding and yield of 5t/ha)

Costs	\$US
Capital related costs: \$7,500 over 10 years	750
Operating costs	
Feed FCR of 1.2 to 1, feed cost \$0.7/kg 43% protein	4,200
Labor: 4 farmhands @ \$70/month	3,360
Fingerlings (32,000/ha @ \$50per1000)	1,600
Other	1,500
Total	11,400
Revenue (@\$3/kg for 5tons)	15,000
Margin	3,590
Profit margin	24%
Return on capital	20%

At the other end of the scale are the intensive water-recycling systems recently developed in southwest Nigeria. An example is the intensive farm set up by Banarly/Olokun in their Lagos processing plant. This is a 250-ton unit using impressive technology, with a nursery unit, and five indoor tank lines where catfish are taken through a closely controlled on-growing sequence. It is a continuous batch process able to sell catfish throughout the year at \$2.3 per kg, with high protein (43%) feed the main input. An elaborate water purification system allows recycling, so water usage is low – it relies upon the city water supply. A similar larger unit is apparently operating in Ibadan (the Zartek farm) and ORC has been operating another recycling unit for over four years. The most important implication of this is the graphic demonstration it provides that complex high-tech aquaculture facilities can be operated successfully in Nigeria.

D. The Nigerian Market

Estimates have put the demand for fish in Nigeria at about 1.5 million tones annually. Unfortunately, local production is not more than 0.5 million tones. In order to fill the gap, Nigeria imports fish. Nigeria is the largest importer of frozen fish in Africa and its annual import bill exceeds N27billion (\$208 million) in 2001. This gap could be filled by local aquaculture.

Export

The bulk of Nigeria's marine products are exported to Europe. There has been slow growth in all sectors, but easily the most important are frozen shrimp. According to statistics, the most important sector is frozen, cooked 'Penaeus' shrimp. Typically, tropical shrimp are sold either headed or de-headed, green, after blast-freezing. The business is in the hands of large-scale trawler fleets, a proportion of which are foreign-owned.

Table 17: Nigeria's Production, Imports and Exports of Marine Products to the EU, ton

CATEGORY	1995	1996	1997	1998	1999	2000
PRODUCTION						
Artisanal fisheries						
Coastal and brackish water	159,200	138,270	175,130	219,070	239,230	239,800
Inland waters	171,750	170,930	185,090	214,000	187,560	181,270
Aquaculture	16,620	19,490	25,270	20,450	21,740	25,720
Industrial fishery						
Fish: inshore trawling	21,190	15,430	15,330	17,950	14,180	13,880
Fish: deepwater	40	2,270	1,570	1,290	1,710	1,380
Shrimp	12,250	9,550	10,810	10,720	15,250	8,060
Total production	381,050	355,940	413,200	483,480	479,670	470,110
% Increase in Production		-7%	16%	17%	-1%	-2%
TRADE						
Imports: fish	266,450	403,270	382,440	373,040	466,840	557,880
Exports						
Frozen Shrimps	5,841	6,587	7,079	6,892	6,557	
Total exports	6,500	7,240	7,990	8,060	7,760	7,510 est.
NET SUPPLY	641,000	751,970	787,640	848,470	938,750	1,020,480
% Increase in Net Supply		17%	5%	8%	11%	9%

Sources: Eurostat, Federal Department of Fisheries, Annex 4.5

The total EU market is some 280,000 tons of prawns and is valued at 2 billion ECU, i.e. \$1.75 billion. Nigeria's exports are valued at some 57 million ECU in the year 2000, i.e. \$50 million. Nigeria in effect holds about 2% of the European market. Important markets are Spain (25% of sales), France, Belgium and the UK.

However, as important as Nigeria is as an exporter of shrimp and other marine products, it is also an equally important importer of marine products. Nigeria imports roughly 550,000 tons of fish valued at approximately \$240million.

D.1. Domestic Market

The Nigerian domestic seafood market is a mix of the modern and the traditional. In the urban centers the wealthy buy western style products (at western prices plus), but the majority of the population, (rural communities and those in poorer urban areas) depend upon traditional markets, mostly selling traditional products. This means that fish is sold fresh (often live) or smoked/dried.

Shrimp, as a very perishable product, is mostly sold smoked, unless sold close to point of capture where fresh/live product can be on sale – this means in coastal markets or markets close to freshwater prawn fisheries. Distribution relies upon small traders who buy and deliver small quantities of dried/smoked seafood to rural markets using local transport – buses etc. This is a trade dominated by women – the “fish mammies”, who tend to control all artisanal post harvest activities throughout West Africa, often within family businesses where the men folk fish while the women manage and sell.

Rural markets are neither hygienic nor clean, with food safety a matter for buyers (who buy live fish, well-cured fish or rely upon items being well-cooked). There has been some impact of western food products upon the traditional sector. Canned fish (small pelagics) has been a Nigerian staple for many years, though it really targets the market for low-cost “storable” protein food rather than seafood per se. Latterly, improved distribution and cold storage networks have allowed a huge increase in marketing of low-cost frozen species (small pelagics like mackerel, pilchard, herring and scads) and Nigeria has become a leading importer of this category. Frozen pelagics now find their way into markets throughout Nigeria.

The wealthy urban market is, in contrast, western in structure and approach to hygiene – products are frozen and retailed in consumer packs. However, this is a small market, and products on sale tend to be expensive imports, or spin-off products from the export industry – shrimp tails, tongue sole fillets, etc.

D.2. Prices

Prices were collected during the reconnaissance in markets along Nigeria’s coastal zone as well as in Lokoja inland, and these are given in annex IV, table VI.3, and summarized in Table 18. In the traditional markets, fish is sold by unit rather than by weight, making price comparison difficult for buyers. Prices varied widely, and for shrimp and prawns, the size-grade price differentials seen in international trade are fully reflected.

Table 18 shows comparative international prices (alongside local equivalents), stated after adjustment to a common product form so that like can be compared with like. Prices of larger size grades of penaeids, in the urban centers were high, relative to international levels, as were those for freshwater prawns. However, the dynamics of price formation are probably very different in these two cases. Freshwater prawns are mainly sold in local markets close to the water bodies where they are caught in a fragmented low volume trade. Penaeid prices though appear to be set by the alternative for the producers – i.e. export. This they do with a hefty

premium to account for the disproportionate cost of dealing with small volumes in the domestic market.

Table 18: Shrimp and prawn retail prices in markets in southern Nigeria

	Nigerian market		International US\$/kg
	N/kg	US\$/kg	
Freshwater prawns	380	2.9	2.5
Penaeid shrimp			
Small dried shrimp (traditional markets)	220	1.7	N/A
Large frozen shrimp (urban wealthy market)	900	6.9	5.8
Large fresh tiger shrimp	975	7.5	7.5

Source: prices collected in domestic markets (see Annex IV)

As a comparison, fish prices were also collected alongside those for shrimp and prawns (see Table 19). Catfish are clearly the preferred species in traditional markets and are found widely in Southern Nigeria sold live, fresh or smoked. Again the parallel wealthy urban market sets high prices for its western style products, but the point of most interest is the fact that catfish outsells freshwater prawns when prices are compared on a like for like basis. This means that the incentive for producing prawns is not as high as might be expected – catfish culture presents an attractive alternative especially as it is a more proven technology with a more robust species.

Table 19: Fish retail prices in markets in Southern Nigeria

Fish	N/kg	US\$/kg
Catfish (Clarias, Heterobranchus, live and smoked)	460	3.5
Tilapia (fresh whole)	200	1.5
Small pelagics (Bonga, imported scad)	65	0.5
Frozen fillet (urban wealthy markets)	600	4.6

Source: prices collected in domestic markets (see Annex IV)

Prices of freshwater prawns:

The price per kg of freshwater prawn varies from \$1.0 to \$4.8/kg - with the Calabar area recording the lowest price, \$1/kg. There is great variability in price, as the product is so perishable and distress selling can lead to very low prices when demand is low, or at the end of the trading day, i.e. in the night markets because of lack of storage facilities.

III. ENVIRONMENT

A. Government Policy

When Nigeria achieved independence in 1960, agricultural exports accounted for over 60% of total export earnings and a similar proportion of the gross domestic products (GDP). In the 1970s and 80s, a combination of increasing petroleum oil production and rising prices brought easy and windfall earnings, which diverted Nigeria's attention and encouraged the neglect of agricultural exports. Over the years, there have been different agricultural policies targeted at improving the performance of the agricultural sector. The objectives of agricultural policy can be broadly stated as follows:

- Provision of self-sufficiency in food and raw materials for industries;
- Improvement of the socio-economic welfare of rural people engaged in agriculture; and
- Diversification of the sources of foreign exchange earnings through increased agricultural exports arising from adoption of appropriate technologies in food production and distribution

While the policies are sound, until the recent return to democratic governance, the will and strategies to implement them had largely been absent during years of military rule. The emergence of democracy required the institutionalization of civil governance structures and the revival of the productive value-adding sector of the economy, which is so strategic in addressing the multifaceted socio-economic problems confronting the nation.

Nigeria does currently have access to several export stimulation incentives:

A.1. Federal Ministry of Finance, Budget Office

In the area of exports, exporters enjoy a couple of government initiatives. The Federal Ministry of Finance, working with several parastatals, including the Nigerian Export Promotion Council (NEPC), Nigeria Export-Import Bank (NEXIM) and local commercial banks, has several export-oriented incentives:

a. Manufacture – In- Bond Scheme

The Manufacture-in-Bond Scheme is designed to encourage manufactures to import duty free raw material inputs and other intermediate products whether prohibited or not for the production of exportable goods, backed by a bond issued by any recognized commercial bank, merchant bank, insurance company or NEXIM. The Bond will be discharged after evidence of exportation and repatriation of foreign exchange has been produced.

b. Duty Drawback Scheme

The Duty Drawback Scheme provides for refund of duties/surcharges on raw materials including packing and packaging material used in the manufacture of products upon effective exportation of the final product.

c. Export Expansion Grant Scheme

The Export Expansion Grant Scheme provides for cash inducement for exporters who have exported a minimum of N500,000 (five hundred thousand Naira) worth of processed products. Exporters of processed products initially received a 4% rebate on repatriated proceeds, which, as of 2002, has been increased to 20%.

This scheme was discussed most often by the exporters interviewed. Due to the 6-8 month delay in payment, there is a secondary market for the Duty Credit Certificates. The Certificates are essentially cash, to be collected eventually from the Government. Usually the exporter sells this certificate to importers through the banks at 10%.

d. Export Development Fund Scheme

The Export Development Fund (EDF) is a scheme developed by the Federal Government of Nigeria to provide financial assistance to private sector exporting companies to cover part of their initial expenses in respect of the following export promotion activities:

- Participation in training courses, symposia, and seminars in all aspects of export promotion
- Advertising and publicity campaigns in abroad
- Export market research
- Product design and consultancy
- Participation in trade fairs, missions
- Cost of collecting trade information and
- Backing up the development of export oriented industries

Also the Nigerian Export Promotion Council meets regularly with exporters to discuss, develop and improve new incentives.

A.2. The Nigerian Export-Import Bank (NEXIM)

NEXIM was established by the Federal Government of Nigeria by Decree 38 of 1991 to replace the defunct Nigerian Export Credit Guarantee and Insurance Corporation with the main objective of providing a commercially oriented and export-stimulating institution that is committed to bringing about export-led recovery as well as a culture of self-inspired and sustained exporting in Nigeria. The bank was established to provide among others: credit in local currency to support Nigerian exports; export credit guarantee and export credit insurance; domestic credit insurance when such a facility will help export; credit insurance in respect of external trade, transit trade and entrepot trade; and investment guarantees and investment insurance facilities. NEXIM maintains a foreign exchange revolving fund for lending to exporters who need to import foreign inputs; raw materials and packaging materials to help export production and a trade information system to support export business. NEXIM also buys and sells foreign exchange.

Presently, NEXIM is mainly involved in the production of financial and risk bearing services, market information export education and advisory services, to mention a few. NEXIM has emerged as the predominant source of short-term trade financing provided to the export sector.

The major financial facilities offered by NEXIM in support of non-oil export include:

a. Rediscounting and Refinancing Facility (RRF):

This helps banks to provide pre and post shipment finance in local currency to support non-oil exports. While the refinancing scheme provides a bank with credit of up to one year, the rediscounting scheme provides short-term pre-shipment credit up to 120 days and post-shipment credit up to 60 days. As at the time of this report, exporters were receiving a NEXIM rediscounting rate of 21% (inclusive of bank charges, about 4%) as compared to commercial bank rate of 35%

b. Foreign Input Facility (FIF):

This provides manufacturers of export products foreign currency loans to import capital equipment, packaging and raw materials to produce finished products for export. The facility was intended to benefit small and medium sized enterprises whose assets do not exceed \$6 million.

c. Stocking Facility:

This is provided in local currency and it enables manufacturers of exportable goods to procure adequate stocks of raw materials to keep their production at optimal levels.

NEXIM Risk Bearing Services include:

- Export Credit Guarantee Facility
- Export Credit Insurance Facility
- Investment Guarantee and Investment Insurance Facilities
- Interstate Road Transit Scheme to guarantee goods transiting Nigeria to other member states of the Economic Community of West African States (ECOWAS)

In 2000, NEXIM was able to generate \$15.90 million of foreign exchange from its Export Credit Rediscounting and Refinancing Facility (RRF), which represents an increase of 99.5% over levels achieved in the previous year. The foreign exchange generated from RRF operations serves as a barometer of effectiveness of NEXIM's export support activities. Besides these export incentives, the Federal Government still has a long way to go with bureaucratic procedures, particularly at the port, and data/information management, which is unreliable and in most cases, non existent.

Under the first National Development Plan, the Federal Government restricted itself to research activities for improving cash crops production. However, following the emergence of many problems, especially food shortages, the government decided to play a more dynamic role in primary production, beginning from the mid-70s. Consequently, the policy instruments adopted were: provision of credit; intensification of agricultural research; input subsidy; price support; manpower development and training; mechanization; land reform and international trade regulation. In order to ensure the realization of policy goals, various institutions were established for supervising or for providing some of the essential supporting services required by the sector.

A.3. The Africa Project Development Facility (APDF)

The APDF was launched in 1986 to support the development of competitive African small and medium enterprises, with services that are needed and affordable, working mainly through local institutions and consultants. The APDF has assisted over 460 enterprises in Sub Saharan Africa. APDF helps to improve operations through capacity building and training. While APDF itself does not provide finance, it helps to source financing from the market and to find appropriate business solutions.

B. Socio-Economic Issues

B.1. Key Socio-Cultural Aspects

A question that permeated discussion from the outset of the assessment was - why is shrimp farming not already underway in Nigeria? The reconnaissance confirmed the original supposition that, technically speaking, there is good reason to believe that it would succeed. The conclusion was that the constraints were then likely to be socio-cultural or economic. The latter aspect is addressed in the Industry Action Plan where shrimp and prawn culture industries are modeled. Socio economic and cultural aspects are discussed below.

Environmental Effects

The erroneous impression created as a result of the media report in some quarters particularly in the Mangrove Forest Conservation Society of Nigeria (MFCSN) was that shrimp were being cultured indiscriminately without regards to the conservation of the mangroves ecosystem of the Niger Delta. The Federal Department of Fisheries was summoned to the Nigerian House of Representative by the House of Representative Committee on Environment to make clarification. The apprehension of the MRCSN has been allayed. The MFCSN has been assured that when shrimp farming is eventually introduced, mangrove-friendly shrimp farming practices will be adopted, especially in light of the fact that mangrove areas are not the ideal sites for shrimp ponds.

In addition to concerns regarding impact on mangroves, shrimp farming can potentially lead to significant pollution of ground water, and requires proper management of effluent. A system of management and inspection by the Nigerian government will be required to ensure that operations process effluent appropriately, segregating the wastes from groundwater.

In 2001, the US Department of State certified Nigeria as one of the 43 nations authorized to export all categories of shrimp to the US, with provisos to protect endangered sea turtle species through the use of Turtle Excluder Devices (TEDs).

B.2. Impact on Incomes

Aquaculture (either shrimp, prawn and/or fin fish) will increase the incomes of both commercial and artisanal fishers.

B.3. Impact On Women

Women, involved in the marketing and sometimes ownership of artisan boats will also experience an increase in incomes.

B.4. Geographical Distribution

Fresh water prawn aquaculture

Freshwater prawn aquaculture can potentially be established in either the southern or northern regions, wherever it is possible to establish a freshwater farm.

Shrimp Aquaculture

The Delta is not an investor friendly environment. The great expansion of the petrochemical industry throughout the Delta has generated resentment amongst the region's inhabitants. The people of the delta may see their resources as being exploited by large external agencies and believe that relatively little benefit is accruing to them. This has generated a compensation ("rent seeking") culture amongst the population of the south Niger Delta (Delta, Bayelsa and Rivers States), accompanied by risk of extortion and worse. This is a major current constraint that would make this area a high cost shrimp producer under present conditions.

The main economic factor in the Delta is the petrochemical industry. In response to local and international pressures, the oil companies there (Shell, LNG, Mobil, Chevron and Agip) have made a significant commitment to community development (e.g. Shell spends \$55m/year in the Delta, Chevron spends \$90m around Warri). The principal objective of these activities is to gain maximum impact within the rural communities though improving livelihoods. Above all, this means that their interventions must be participatory, and "owned" by the communities.

Consequently their interest in aquaculture is strictly small-scale, aimed at the family or village level. This means that:

- i. The oil sector will not be potential sponsors for a pioneering shrimp farming industry
- ii. The companies' reasons for not wishing to do so need to be understood by other potential investors – there is a real risk of being seen as external exploiters rather than generators of worthwhile employment and economic spin-off for the local communities. On-costs in terms of security requirements and compensation claims will be high.

Small-scale aquaculture is being supported by the oil companies, who could be a major driving force for the development of the freshwater prawn sector.

A second and not unconnected constraint in the Delta is access to land – it is expensive, and ownership is frequently contentious. Even coastal swampland that is theoretically Government/State owned is claimed by the local community. This seems much less true to the east towards Calabar where the village culture is reputedly more self reliant and land ownership

issues less complicated.

IV. OPPORTUNITIES AND CONSTRAINTS

A. Issues, Trends and Opportunities in Shrimp and Prawn International Market

- Overall demand has been increasing at 3% p.a. with the US market growing at 5%. This is considered to be a booming market. Production has shown a steady increase to meet with demand with farmed shrimp contributing 25% and estimated to increase to 50%. This provides a huge opportunity for beginning and/or increasing farmed shrimp provided it can be produced competitively at current lower price levels.
- Prices for shrimp have remained remarkably stable for the past 20 years during which the farming industry has developed, in spite of the huge increase in output that farming produced (farmed production has grown by 100% over the last 10 years).
- The premium for white shrimp (vs. black tiger) has reduced/vanished lately and it seems that apart from specialized markets (e.g. Spain) black tiger has managed to successfully replace white species, even in white shrimp-orientated markets such as the USA.
- Nigeria should continue to target the EU markets, especially where niche advantages can be exploited, and explore opportunities in the growing USA market.
- An aspiration for a \$200million industry with an annual output of 40-50,000 tons (whole shrimp) would add only about 2.8% to current OECD supplies of tropical shrimp and 11% to European supplies (this being the market that currently takes most Nigerian products).
- Two species of shrimp have now come to dominate the farmed sector: Asian black tiger (P. monodon) and Latin American white shrimp (P. vannamei). Commercial shrimp culture in Nigeria will have to be based upon one of these, as the indigenous species (P. notialis) has yet to be proven acceptable as a farm animal (no hatchery technology, for example). The question is then which farmable species Nigeria should opt for, and from a market perspective, the answer seems to be moving in favor of black tiger.
- Freshwater prawn farming looks dubious as an export-orientated venture. Prices have declined by more than those of comparable penaeid marine products, and this differential is exacerbated by the relatively poor tail meat yields of prawns (42% rather than 62.5%). Furthermore, the international market favors penaeid shrimp over freshwater prawns (a traditional 50% premium in favor of penaeids, on like for like basis, has moved up to 100% this year so far). Unless there is an extensive freshwater fish culture sector to which prawn farming can become a low cost add-on, the economics of commercial prawn farming for export will prove questionable – as it has in other parts of the world. However, the economics of production for the Nigerian domestic market are more positive as subsequent sections show.
- Nigeria should adopt mangrove friendly, environmentally safe technology for both shrimp and prawn aquaculture.

B. Issues, Trends and Opportunities in Nigerian Shrimp and Prawn Trade

Market

- The local market pays equal or higher prices for freshwater prawns than those achievable in the export market. Domestic prices for shrimp (penaeids) are the equivalent or higher than international prices. However, comparisons are difficult as the products differ greatly - and exact comparability is important given the large grade-based price differentials.
- Where “commercial” shrimp products (i.e. export formats) are concerned, Nigerian urban prices (and this is a luxury urban food item) exceed international levels - i.e. Nigerian processors sell at a local premium - perhaps to account for foreign exchange foregone or the relatively higher cost of retailing small quantities.
- Catfish prices are relatively high - 250-450 Naira/kg (\$2 to \$3.5/kg). Production costs are also relatively high (feed is \$700/tonne with a 1:1.2FCR, so feed costs are \$0.85/kg) but the margin for labor, capital cost and hatchery/fingerlings is still more than adequate at \$1.5-\$2.0/kg. This is what prawn farming must equal or exceed to encourage investors.
- Prices for herbivores or detritus feeding fish such as tilapia, which could be polycultured with freshwater prawns, are relatively low (N200 or \$1.5/kg), so prawn/fish polyculture may not provide the scope seen recently in Southeast Asia.

Aquaculture

There is a clear duality between penaeids (marine shrimp) and *Macrobrachium*/freshwater prawn (FWP) culture - the former is large scale, technically advanced agri-business that needs to be oriented towards export. The latter (FWP) is mostly done as a smaller scale, rural enterprise integrated within polyculture/mixed farming. It is adaptable to small-scale community schemes provided hatchery technology can be developed.

Marine

- *Penaeus monodon* (the Asian giant black tiger shrimp, the basis of 85% of global shrimp culture) is present as an exotic in the delta regions fauna - confirmed at Bonny Island and Eket/Ibeno - and now contribute as much as 10% to catches. This has two implications: (i) using *P. monodon* in a Nigerian prawn farming industry would no longer be an introduction of an exotic and (ii) there should now be source of gravid (egg bearing females) that hatcheries can source locally (an essential hatchery input as the industry has yet to “close the circle”).
- The choice of a farm animal for a prospective Nigerian shrimp farming industry should then be black tiger (*P. monodon*) rather than a white exotic species.

- Accepting that this was only the briefest of reconnaissance, there seems to be no technical reason why penaeid culture should not succeed in Nigeria. Suitable sites can be found in the Delta-Calabar region and to the west of the Delta.

Freshwater Prawns

- There is activity and much interest in the Delta in freshwater prawn farming. However, there are currently no farming operations apart from one small low input farm near Calabar.
- Government sponsored aquaculture facilities visited in the southern states were not working, and other studies have found the same for government-sponsored projects in the central and northern regions (Winrock/USNGDI study by Jim Miller in April 2002).

Catfish

- The only significant aquaculture actually underway (commercially and developmental) is fish culture - mainly catfish (*clarias* and *heterobranchus* sp). High prices paid for catfish (\$2.5-3/kg whole weight) makes this viable. It is not compatible with freshwater prawn polyculture though, as catfish are aggressively carnivorous, so prawn farming cannot be simply added incrementally to existing fish culture systems as in some Asian models. Tilapia culture (which could lend itself to this) is less attractive, as tilapia sells at a large discount to catfish (\$1-1.5/kg)
- That said, catfish recycling culture projects such as those developed by Banarly and (reputedly) by ORC and Zartek in Ibadan show that, given sufficient economic justification, Nigerian fishing companies are clearly capable of effective diversification, and able to fund and develop sophisticated technology (of the sort required for a shrimp hatchery) to do so.

The most important implication of this is the graphic demonstration it provides that complex high-tech aquaculture facilities can be operated successfully in Nigeria.

V. CONCLUSION AND RECOMMENDATIONS

Shrimp has become a significant international commodity with OECD markets worth \$8.6 billion, and Nigeria has all of the inputs necessary to take full advantage of this growing market.

The central theme to a strategy for developing this sector in Nigeria is the duality between marine shrimp and freshwater prawn culture in a Nigerian context. Shrimp culture needs to be done on a scale that precludes artisanal participation for a number of reasons: – the need for a complex hatchery, the difficulty of construction in remote, exposed coastal zones, the cost of supply and drainage channels and processing requirements for a product targeted on export markets. This means that shrimp culture tends to be a large-scale commercial agribusiness. In contrast, freshwater prawn culture in Nigeria (as in most other areas) is likely to be mostly undertaken as a small-scale activity at the village level.

In light of the opportunities and constraints examined in the subsector assessment, the authors propose a goal to increase Nigeria's shrimp and prawn production to meet both domestic and export demand through aquaculture.

To achieve this goal, the specific objectives include:

- To increase Nigeria's share of the world shrimp market from \$56 million to over \$200 million in 10 years.
- To increase jobs, through increased employment in the farms, processing plants and other ancillary industries.

A.1 Approach

An Industry Action Plan has been developed to supplement the subsector assessment. The IAP details proposed strategies, activities and timelines. Below is a short synopsis of the key strategies recommended.

A.2 Implementation

A dual program is proposed: – shrimp as a large agribusiness of interest to substantial investors with a mid to long-term investment horizon, while freshwater prawns are seen in terms of improving rural livelihoods. This would be through revenue generating activities that are incremental to existing aquaculture or agricultural activities.

Action steps include a full feasibility study to validate assumptions and identify appropriate locations for a “pilot” project. Once the technology is proven and commercially viable, it will be replicated throughout Nigeria.

In order to coordinate both programs, industry stakeholders suggest the establishment of a Shrimp/Prawn “Action Team” with membership from the following key areas:

- 1 Multinational (Shell Oil Company)
- 1 Private Sector (i.e. Ocean Fisheries)

- 1 Public Sector (Federal Department of Fisheries/PCU)
- 1 Research Institution (NIOMR)
- 1 Commercial Bank (i.e. NACRDB)

APPENDIX I: SWOT ANALYSIS OF THE NIGERIAN SHRIMP INDUSTRY

In the course of this study, the strengths and weaknesses within the Nigerian shrimp industry, and opportunities, and threats within the international shrimp market have been captured. The purpose of this SWOT – Strength, Weakness, Opportunities and Threats analysis is to provide basic information for investment appraisal within the industry in Nigeria. There is an important corollary of this though, in that the inevitable uncertainty about many of the factors discussed means that a cautious pilot approach will be essential for pioneers who take up this challenge.

STRENGTHS

- Nigeria's successful shrimp processing industry has allowed it to gain certification for seafood export by European Union and to the USA sanitary authorities.
- There are suitable exotic farmed shrimp species, particularly *Penaeus monodon*, and possibly suitable local freshwater prawn species in Nigerian waters.
- The intensive recycling catfish farms in Lagos demonstrate the commercial fisheries sector's ability to run complex commercial aquaculture systems well, suggesting that shrimp hatcheries would be successful.
- The availability of high quality shrimp processing facilities with export experience and HACCP certification by the Lagos commercial players are important assets, as are the prospects for contract processing of farmed shrimp output.
- The potential that shrimp culture has for generating exports in an economy that is oriented towards obtaining foreign currency.
- Large areas of potentially suitable land for shrimp culture that are currently unused or lightly used.
- The sustainable physical environment for shrimp/prawn culture.
- The local demand for shrimp provides additional marketing outlets for the increased production.

WEAKNESSES

Cultural Issues

- Land acquisition in the Delta by outsiders is very difficult and expensive.
- The Nigerian commercial environment's tendency to foster short term investment seeking rapid profits – i.e. orientated towards trading rather than primary production
- The high poaching risk which would require close supervision of farms and costly security arrangements

Economic Issues

- The high cost of credit in Nigeria. The potentially high operational costs in key potential locations for marine shrimp culture in the Niger delta. Poor infrastructure (communication, services, utilities) in areas suitable for commercial shrimp culture

Technical Issues

- Limited knowledge of freshwater prawn culture in Nigeria, and inability as yet to produce post larvae artificially. The number of failed government-owned aquaculture projects, and the poor

funding for research and extension services

OPPORTUNITIES

- In commercial marine shrimp culture, the potential for creating an industry that could conceivably generate output of over \$200 million (i.e. twice that of Nigeria's cocoa sector)
- The potential for culturing shrimps for export to gain foreign exchange and redress the current highly negative seafood trade balance
- Prospect for producing freshwater prawns as a small scale activity that could increase rural incomes and employment enhancement
- Potential for rice/prawn culture or tilapia/other local fishes (herbivorous) polyculture with prawns to augment farmers' incomes in swamp rice growing areas
- The potential that shrimp farming would present for employment generation in areas that currently have few alternatives, and where labor could be returning as major petrochemical construction projects are completed over coming years
- The potential to create rural jobs to stem the drift to the major urban centers
- The spin-off potential for developing ancillary industries such as feed production, hatchery operations, packaging, etc., and especially for increasing raw material supplies to the currently declining shrimp processing industry

THREATS

- The recent sharp decline in shrimp prices in a formerly stable international market
- Surging farm shrimp output in South and South East Asia, presenting a future threat to markets
- Global shortages of fishmeal, a key feed ingredient, might decrease farming output.
- Global pond capacity is underutilized and could eventually produce a lot more when technology allows.

APPENDIX II: SHRIMP BIOLOGY AND THE PRODUCTION PROCESS

Penaeid shrimp (Marine/brackish water)

Penaeid prawns live in tropical waters, usually in brackish or reduced salinity water over shallow banks off major river systems. This reflects a life cycle that moves between estuarine and marine conditions, with breeding occurring at sea, followed by a planktonic larval phase involving a number of stages of free-swimming larvae. After less than a month the “postlarvae” (PLs, minute, but fully “shrimp-shaped” juveniles) migrate inshore to estuaries where they grow in brackish water and mangrove swamps on rich river-borne sediments. They move into deeper water as they grow, and upon maturing they reach offshore grounds, ready to breed again.

Farming addresses this cycle in a three-phase process: a hatchery where the free swimming planktonic stages (nauplii, zoea, mysids and postlarvae, in growth order) are cultivated in highly aerated water in indoor tanks. Producing appropriate feeds for the larvae as they develop is crucial, and the hatchery has to produce first phytoplankton and then zooplankton (although artificial feeds are replacing the need for the latter now). This means that the hatchery is effectively a complex commercial micro-biological laboratory, highly sensitive to pollution and disease contamination, and requiring good technical management. So far, there has been relatively little success with persuading farmed shrimp to breed in captivity, and most hatcheries rely upon wild gravid females, caught by commercial fishermen, to provide eggs. This adds a further hazard, as the hatchery has to rely upon a fishery as well as its own complex operations for success. Indeed this dependency upon wild supplies has led to very high prices for gravid females when the fishery fails. In some regions wild postlarvae can be caught by inshore fishermen to supply the farms.

The juvenile stages are often reared in nursery ponds - small earthen ponds where they are fed a fine particulate diet. Increasingly this stage is being replaced by simply netting off a portion of the on-growing ponds. Finally, the bulk of the farm, the on-growing ponds that take the juveniles through to market-size, consists of large earthen ponds, with seawater supply and drainage systems. There are three principle approaches to the on-growing stage:

(i) Extensive farming; large ponds (10-20ha plus) built on the littoral, within the tidal range and so tidally flushed, seeded by wild postlarvae from incoming water, employing minimal inputs to achieve yields of 0.5tons./ha or less. This depends upon the low-cost availability of exactly the right land, naturally and reliably brackish water and a large, adjacent wild shrimp stock. The main problem with extensive culture is that, although inputs are low (and so inexpensive) so are outputs, and the revenues generated tend to be insufficient to amortize the high cost of building the ponds. In fact, it works best where extant ponds (like Indonesian tambaks or Bangladesh rice paddies) are converted to shrimp culture at low cost.

(ii) **Semi-intensive farming**; involves smaller ponds of 1 to 10ha, constructed above the littoral and relies upon pumps for water exchange. As well as pumping, these farms require significant inputs, including stocking with post larvae (100 to 300,000 per ha) either hatchery produced or wild caught. They also require water fertilization (to encourage planktonic food’s growth) or feeding to give yields from 0.75 to 5 tons per ha, the latter requiring heavy inputs and aeration.

(iii) Intensive farming: uses small ponds or concrete tanks, requiring very high inputs to give high yields, and is relevant where land is scarce, construction expensive and infrastructure advanced. Very high yields, of 8 to 20 tons per hectare per year, are achieved by multiple annual cycles, but require very high inputs (300,000 plus postlarvae per hectare, heavy feeding, high pumped water exchange (30% per day) and aeration). However serious disease problems have undermined most such industries (Taiwan, Thailand and Japan) and anyway these units tend to be relatively high cost producers.

Freshwater Prawns: Macrobrachium

Freshwater prawns are a separate segment of the market. Traditionally they were favored in the Thai domestic market and indeed Thailand was the main producer. Latterly, China, India and Bangladesh have started to produce them in quantity. They are more aggressive than penaeids and so don't lend themselves to intensive culture well – indeed it appears that recent growth in Subcontinent and Chinese production has been the result of rearing *Macrobrachium* at low densities in extant fish farms – i.e. in polyculture with carps and tilapia. They then provide additional revenue for little extra work or input. They grow larger than penaeids and *Macrobrachium rosenbergii*, the main farmed species, has long blue claws making it a restaurant showpiece.

However, prawns have a major disadvantage in that their usable meat yield is much lower than that of penaeids – about 40%, as opposed to more than 60%. As their prices are significantly lower than those of penaeids (on a like for like basis, i.e. comparing same size grade of tails), this leads to relatively low financial yields. They are sold in the USA but in low volumes and are more popular in Europe. Here, it is the ethnic and restaurant trade that buys them, i.e. they are not part of the mainstream commodity trade in penaeids and pandalids.

APPENDIX III: POTENTIAL FOR SHRIMP FARMING

Climatic and Physical Parameters

Penaeid shrimp generally require salinities of 15 to 25 ppt. and temperatures optimally between 25 and 30°C. The climatic conditions in the Delta fit this envelope well, as the data in annex V show. The tidal range is 1.0 m neaps, 1.9m springs (Admiralty charts for the Bonny/Port Harcourt area) and so there is scope to build fully drainable ponds at a level where they can at least be partially tidally filled. Some incidental salinity testing was done during the reconnaissance mission (Annex I), and this only found brackish water conditions close to the marine interface (i.e. at the edge of the Delta).

Potential sites for shrimp farming

The reconnaissance mission made a cursory survey of a few coastal sites, and the outcome cannot be seen as in anyway a comprehensive survey. However it was clear that there were large areas of flat, low forest or scrub areas behind the mangrove belts. The salinity levels encountered suggest that brackish water of stable and sufficiently high salinity will only be found close to the sea itself – the water in the estuarine networks is mainly freshwater or of low salinity, at least during the rainy season.

Zones

The Nigerian coast is characterized by a recent sediment structure throughout, with two types predominating – (i) sandy shelving coasts, frequently backed by an inland lagoon, running in parallel, and (ii) estuarine swamps with mangrove and freshwater swamp forest, dominated by the Niger Delta. The latter coastal type provides potential shrimp culture terrain, and includes at least three major zones:

- (i) The Niger Delta itself is characterized by huge areas of swamp land (saline and freshwater), complex networks of tidal channels and islands, and inaccessibility other than by boat or helicopter. The coastline is punctuated by numerous large estuaries and saline/freshwater swamp land extends at least 50km inland over most of the Delta.
- (ii) The East Coast between Bonny and the Calabar Estuary which has a narrow mangrove belt behind which there is extensive swamp forest, but this is more terrestrial than the delta with coastal road access in places, and occasional estuaries. There is a risk that the soil is too sandy to make stable pond bunds, but there are clay areas and supposedly a clay horizon underlies the sand.
- (iii) The coast west of the Delta in Ondo, Ogun and Lagos states up to the Lagos & Lekki lagoons. This area was not visited but was seen from the air and from air photographs, and the NLVU maps shows it to be characterized by a narrow coastal mangrove barrier, behind which there are extensive tidal/salt marsh flats and along which an inland canal runs for some 65 kilometers.

Table 20: Marine swampland in Niger Delta

River system	Swamp area hectares
Escravos	95,000
Forcados	81,000
Brass	44,000
San	65,000
Bartholomeo	52,000
Sombreiro	49,000
New Calabar	42,000
Bonny	15,000
Other	297,000
Total	740,000

Source: Dr O Elliott, Seminar on the Nigerian Fisheries Industry, June 2001, Abuja Sheraton

The mangrove issue

Apart from environmental concerns, mangrove areas are anyway best avoided, for four good reasons: (a) they are inter-tidal, so ponds constructed in this zone cannot be drained easily, causing problems with maintenance, husbandry and harvest. This is limiting for semi intensive culture. (b) Mangrove areas are very expensive to clear and construct in because of the strength of mangrove root systems (c) when ponds have been built, the residue of mangrove roots in the soil decompose and the resulting humic acid lowers the pH to levels that impede shrimp growth. This was a serious problem for some pioneer projects. Finally, (d) storm surges pushed by strong onshore winds can devastate pond bunds, and the best protection against this is a mangrove barrier to attenuate the high waves. Indeed extensive mangrove replanting has occurred in some areas to reinstate the mangrove belt as protection.

Potential sites: target areas

Specific sites cannot be identified from the cursory survey undertaken for this study, but areas where sites should be sought can - and that is the objective here. Taking the considerations outlined above into account, alone suggests that it would be only the Eastern or Western borders of the Delta where potential would be sought. Salinity consideration require sites reasonably close to the sea, and access to essential infrastructure (road access, energy, services etc) militate against the many swamp islands in the Delta area –consequently, the area where pioneer project would best be located would seem to actually be those outside the main delta region, and two zones are suggested:

- (i) The Akwa Ibom state coast between Bonny and the Calabar estuary. Extent - 375 km² of coastal mangrove/swamp forest along a 75km coastal strip. Of this, 90k km² are close to both fresh and saltwater sources. There are also some 7.5 km² of tidal mudflats on the northern end of Bonny Island and on the mainland to the north.
- (ii) The Ogun and Ondo States coast between Lekki Lagoon and the Delta: Extent - 475 km² of coastal mangrove/swamp forest lying along the parallel coastal canal, within which

are 110 km² of tidal mud flats and salt marsh, potentially best suited for shrimp culture.
Sources: NVLU maps based on satellite imagery

Environmental issues

The other key issue is pollution, and especially the risk of hydrocarbon pollution in view of the oil industry activities in the region. However, experience shows that the principle pollution risk to shrimp farming has been internal – i.e. shrimp farm effluent being recycled and so encouraging disease and spreading it to neighboring farms. This is a design and industry regulation issue, and one unlikely to arise until the industry has developed and matured.

Infrastructure and economic context

The main infrastructure requirements for a shrimp farm are access, preferably all weather roads, and energy for pumping, cold storage and normal backup services. Access to engineering facilities for repair and maintenance and communications generally are necessary as is the proximity to a port where key inputs (feed) and product (frozen shrimp) can be landed/shipped. The Ogun and Ondo coast are more accessible, and the coastal canal provides a direct boat access along the length of the area of interest. Lagos is some 150km to the west and this would be the servicing center.

Labor

There is an extensive workforce in western Akwa Ibom. The labor situation in coastal Ogun and Ondo was not investigated, but there are a series of communities along the coast (Olokota, Ogogoro, Olokun, Aiyetoro, Mahin) and so this would seemingly not be a constraint. Unskilled labor costs are put at \$2.7 (N350) per day, while watchmen cost \$75 (N10,000) per month, drivers cost \$150 (N20,000) per month and foremen cost \$270 (N35,000) per month.

Feed

Apart from energy and labor, the other main input for shrimp farming is feed, which can be 50% or more of all costs in an efficient farm. There is a need for commercial feed companies to emerge to significantly support shrimp culture development in Nigeria, especially since the raw materials are locally available – oil palm kernel meal, brewery waste etc

APPENDIX IV: PROJECT BACKGROUND

Before independence, Nigeria's economy was largely sustained through agricultural exports. Major industries such as Unilever Plc, Paterson Zochonis Plc, etc., depended on agricultural raw materials from Nigeria and other Commonwealth nations in the tropics and export trade in agricultural commodities accounted for over 60% of Nigeria's export earnings. Apart from this, the sector also accounted for a similar proportion of the nation's Gross Domestic Product (GDP) and it was the largest source of employment. In the 1970s and 1980s, a combination of increasing petroleum oil production and rising prices brought easy and windfall earnings, which diverted Nigeria's attention and encouraged the neglect of agricultural exports. The country invariably lost its competitive advantage in certain commodities, which it had painstakingly established.

While one cannot blame agricultural neglect alone for the nation's dwindling export trade in agricultural commodities, other factors such as increase in industrial activities in the country, government policies on local value added commodity processing, finance, pricing, etc., have all contributed to the weakening of the nation's capacity to participate effectively in the commodity export trade. Over the years, there have been different agricultural policies targeted at improving the performance of the agricultural sector and reviving export trade in semi-processed agricultural commodities. These policies focused mainly on:

- Provision of self-sufficiency in food and raw materials for industries;
- Improvement of the socio-economic welfare of rural people engaged in agriculture; and
- Diversification of the sources of foreign exchange earnings through increased agricultural exports arising from adoption of appropriate technologies in food production and distribution

While the policies are sound, until the recent return to democratic governance, the will and strategies to implement them had largely been absent during years of military rule. The emergence of democracy required the institutionalization of civil governance structures and the revival of the productive value-adding sector of the economy, which is so strategic in addressing the multifaceted socio-economic problems confronting the nation.

Nigeria plays a strategic role in the stability of sub-Saharan Africa and the challenges associated with rebuilding the economy of such a huge nation whose economy had been mismanaged and ravaged as a result of poor governance are enormous.

The United States Government through its Agency for International Development (USAID) is assisting the Nigerian Government and its people rebuild the socio-economic and political structures of the nation. Accordingly, a strategic plan, which focused on five strategic goals, was developed. These strategic goals are to:

- a. Sustain Nigeria's transition to democratic governance;
- b. Strengthen Nigeria's institutional capacity for economic reform and enhance its capacity to revive agricultural growth;
- c. Develop the foundation for education reform;
- d. Increase the use of family planning, maternal and child health services and HIV/AIDs/STD preventive measures; and

- e. Improve management of local infrastructures and the energy sectors.

To help revive agricultural growth, the Government of Nigeria (GON) requested USAID/Nigeria's assistance to determine which agricultural products have the greatest potential to increase foreign exchange and create jobs. The GON is convinced that a realistic business plan to maximize Nigerian's agricultural potential must be based on sound information, an analysis of what actually exists, and a clear understanding of the constraints in the sector that inhibit the GON and the Nigerian private sector from capitalizing on these opportunities.

Chemonics International is working with USAID/Nigeria and Government of the Federal Republic of Nigeria (GON) to meet these objectives. The following three-phase approach was designed to achieve these objectives:

- I. Assessment of the Global Market for Agricultural Products;
- II. Evaluation of Nigeria's Agricultural Sector; and
- III. Agricultural Industry Action Plans

The final result will be the submission of a number of Industry Action Plans (IAPs) that will be implemented as part of a comprehensive agricultural competitiveness program that would be supported by USAID and other international donors as well as the international and Nigerian private sectors.

- I. Assessment of the Global Market for Agricultural Products.

The first phase was a broad overview of the world market for agricultural products, including products that are currently, or potentially could be, produced in Nigeria. The global markets, including the Africa region, were evaluated using a rigorous methodology and evaluation criteria that was developed by consultants experienced in global markets for tropical agricultural products. For example, the set of criteria included existing consumer demand, trends in market shares, capital requirements, product distribution, commodity prices and volatility, financial returns, etc. The results of this assessment produced a prioritized list of the most promising global marketing opportunities for current and prospective Nigerian agricultural export products.

- II. Evaluation of Nigeria's Agricultural Sector: "The Agriculture Commodity Summit."

In collaboration with the Project Coordinating Unit (PCU) of the Federal Ministry of Agriculture, and the Nigeria Export Promotion Council (NEPC), Chemonics International held a stakeholders' summit on Nigerian agricultural exports in Abuja in January 2002. The summit was attended by more than two hundred participants and stakeholders who helped to identify and recommend, for further study in the Agricultural Industry Action Plans, those commodities that had the greatest potential for creating increased economic growth, external and internal trade, opportunities for employment and increased income and wealth for Nigeria.

Facilitated by local and expatriate consultants, the summit pulled together local experts, stakeholders and public officials who jointly developed a comprehensive list of opportunities matching existing and potential Nigerian agricultural products with current and forecasted world

demands. The summit combined completion of questionnaires (during the summit meeting) with the discussion of the rank-ordered list of commodities for domestic production and export potentials.

The summit also created a high profile public and private sector buy-in for this approach to agricultural competitiveness and demand for the “downstream” activities’ industry action plans, and possible constituencies/partnerships for the eventual implementation of the action plans.

From the summit, the following commodities were chosen for in-depth study:

1. Ginger
2. Gum Arabic
3. Sesame
4. Cashew
5. Leather/Skins
6. Marine Products (prawn farming)

Following the summit, a team of consultants including expatriate and local industry experts conducted “validation visits.” These visits were to selected sites and stakeholders (exporters, processors, producers, etc.) and were designed to confirm information and gather data necessary for preparing useful action plans.

III. Industry Action Plans

Industry Action Plans are being developed for the top, most promising commodities selected from the agricultural commodity summit. These action plans or “road-maps” will identify weak links in the commodity chain that limit competitiveness and suggest practical steps for overcoming them. This analysis includes private and public sector individuals most active in the selected commodity. The plan will focus on actions for the private sector to follow, particularly individuals interested in establishing and/or expanding their presence in the export of Nigerian agricultural products. The action plan will also identify interventions appropriate for USAID and GON support to both increase and accelerate private sector agribusiness activity within the commodity chain.

APPENDIX V: RECONNAISSANCE ITINERARY AND CONTACTS

Monday 5th August 02: Flight to Lagos

Tuesday 6th: Lagos, meeting with the team: Remi Osijo, Consultant and Professor Martins Anetekhai of Lagos State University (LASU), Meeting with Dr Olubunmi Elliott President of the Nigerian Trawler Owners Association. Visit to Badagry to visit Prof. Anetekhai's fish farm and visit Badagri fish market. Meeting with Leslie Flagg Chemonics RAISE Program Manager. Presentation by Nigerian Institute for Oceanography and Marine Research (NIOMR) staff on shrimp-related aspects under Dr Thomas Ajayi on Victoria Island

Wednesday 7th: Lagos, Ibadan: team with Leslie Flagg and Professor Biyi Daramola of Chemonics visit to Epe: Macrobrachium hatchery and fish market and Asejire Reservoir near Ibadan

Thursday 8th: Flight to Port Harcourt: Visit to the AGIP Green River project at Obricom (clarias hatchery) and Ellah fish farm. Meeting with Dr Stanley Akele, Program Manager for AGIP's Community Program, Frank Ellah and Sandy Agowah of Ellah Farms.

Friday 9th: Rivers state: meeting with Shell Nigeria's Corporate Community Program (Olukayode Soremekun, Development Adviser; Suoton Amade, Agriculture Projects Team Leader; Onyechi Okolo, Freshwater prawn consultant from Alpha-Lynx). Visit to Shell's Iriebe demonstration farm and prawn ponds near Port Harcourt. Meeting with NIOMR resident expert (by Remi Osijo) and trip (Nigel Peacock and Professor Martins Anetekhai) to Yenegoa in mid Delta (on route to AGIP farm at Brass - trip abandoned due to lack of time)

Saturday 10th: Rivers and Akwa Ibo states: Trip to Eket and Ibeno in Akwa Ibom via Aba and Uyo. Visit to fish markets, Mobil Terminal (Qua Ibo estuary).

Sunday 11th: Rivers State, trip to Bonny Island by launch, visit to Bonny town fish market, Finima town and the LNG plant fish merchant and management (Sebastian Oyegun, Community Relations Manager). Return to Lagos.

Monday 12th: Lagos, meetings with Sam Azebeokhai, President Nigerian Trawler Owners Association (NITOA) at Apapa, Banarly/Olokun shrimp processing plant and catfish recycled water unit in Ebute Metta (N. V. Sugathan) and follow up meeting with NIOMR staff.

Tuesday 13th: Flight to Calabar (MA) and Abuja (NP, RO), trip to Lokoja on Niger Benue confluence to visit inland fish market

Wednesday 14th: Abuja, at Chemonics office devising presentation and report writing. Obtaining the Nigerian vegetation maps

Thursday 15th: Abuja, presentation to Federal Ministry of Agriculture and Rural Development Project Coordinating Unit (PCU) on findings (Dr. S. A. Ingawa, Head of Unit; G N Asala National Coordinator Fisheries)

Friday 16th: Abuja, presentation to USAID, (Tom Hutcheson, Abdulkadir Gudugi), flight to Lagos, Presentation to NIOMR

Annex I

Table 1.1: Global shrimp production by fishing & farming (unit '000 tonnes)

	Fisherie s	Farming			Total	Farmed %	Growth pa
1975	1,331	13	*		1,344	1%	
1980	1,570	75	*		1,645	5%	
1885	1,855	200			2,055	10%	
1990	2,001	633			2,634	24%	
1991	2,146	690			2,836	24%	8%
1992	2,230	721			2,951	24%	4%
1993	2,311	609	Western	Eastern	2,920	21%	-1%
			hemisphere	e			
1994	2,385	733			3,118	24%	7%
1995	2,440	712	154	558	3,152	23%	1%
1996	2,554	693	172	521	3,247	21%	3%
1997	2,629	660	198	462	3,289	20%	1%
1998	2,749	813	226	587	3,562	23%	8%
1999	3,034	845	172	673	3,879	22%	9%
2000	3,081	1,098	160	938	4,179	26%	8%
2001	2,873	1,236	136	1,100	4,109	30%	

Sources: FAO/World Shrimp Farming, FAO Globefish, LMR Fisheries Research

* mainly extensive lagoon production and Japanese kuruma prawns

Table 1.2 Farmed shrimp production by location

	Western hemisphere						Total
	Ecuador	Brazil	Mexico	Colombia	Honduras	Other	
1995	100,000	-	12,000	11,000	10,000	21,000	154,000
1996	120,000	-	12,000	<i>10,500</i>	10,000	19,800	172,300
1997	130,000	4,000	16,000	10,000	12,000	26,000	198,000
1998	155,000	<i>9,500</i>	17,500	18,000	12,000	13,500	225,500
1999	94,000	15,000	20,000	20,000	10,000	12,500	171,500
2000	54,500	25,000	33,000	25,000	12,000	10,000	159,500
2001	30,000	25,000	32,000	25,000	12,000	12,000	136,000

	Western hemisphere									Total	GRAND TOTAL
	Thailand	China	Vietnam	Indonesia	India	Bang'desh	Philippines	Taiwan	Other		
1995	220,000	70,000	50,000	80,000	60,000	30,000	25,000	7,000	16,000	558,000	712,000
1996	160,000	80,000	30,000	90,000	70,000	35,000	25,000	6,000	24,700	520,700	693,000
1997	150,000	80,000	30,000	80,000	40,000	34,000	10,000	14,000	24,000	462,000	660,000
1998	<i>175,000</i>	<i>95,000</i>	<i>47,000</i>	<i>90,000</i>	83,000	<i>34,500</i>	<i>25,000</i>	<i>14,500</i>	<i>23,000</i>	587,000	812,500
1999	200,000	110,000	<i>64,000</i>	100,000	70,000	<i>35,000</i>	40,000	15,000	39,000	673,000	844,500
2000	300,000	210,000	69,000	138,000	74,000	54,000	41,000	10,000	42,000	938,000	1,097,500
2001	310,000	225,000	-	90,000	100,000	55,000	-	10,000	-	1,100,000	1,236,000

Values in italics: estimates based on trends

Sources: FAO/Globefish, Shrimp News International

Table 1.3: Global production per major shrimp group 1995 & 2002

Unit: '000tonnes		1995	2002	1995	2002
Warm water species				% of output	% of output
Penaeids	OECD markets	1,500	1,840	48%	45%
Penaeid relatives (meta,para, trachy, xipho-penaeus)		260	370	8%	9%
Cool water species					
Pandalids	OECD markets	310	365	10%	9%
Crangon, pleoticus etc	OECD markets	40	40	1%	1%
Acetes (Akiami paste shrimp)		350	640	11%	16%
Other		650	800	21%	20%
TOTAL		3,110	4,055	100%	100%
OECD marketed species		1,850	2,245	21%	increase
Farmed production		1985	1995	2002	
		Pre farming levels	Farmed output	Farmed output	
P monodon	Asian black tiger	110	500	800	
P vannamei	Western white	50	110	150	
P chinensis mainly farmed in China		110	80	200	
			690	1,150	
				(Nigeria 5-15,000tonnes)	
P notialis (Southern pink shrimp)			20		
Source: FAO, Globefish, trade press					

Table 1.4 Domestic production by the main OECD shrimp users - 1990-2002 (Product weight)

Units: tonnes	North America			Europe EU			Europe non-EU	Total OECD	Total OECD	Total OECD
	cold water whole	warm water tails	Total whole	cold water whole	warm water whole	Total whole	Pandalus whole	Coldwater Pandalids crangon whole	Warmwater Penaeids whole	All species whole
1990	37,398	82,070	163,659	25,790	45,341	71,131	163,629	226,817	171,602	398,419
1991	26,975	77,077	145,555	34,511	42,459	76,970	173,034	234,520	161,039	395,559
1992	45,405	69,360	152,113	37,746	39,084	76,830	169,304	252,455	145,792	398,247
1993	32,630	63,504	130,329	36,534	34,100	70,634	184,525	253,689	131,799	385,488
1994	25,549	63,550	123,318	40,472	36,471	76,943	183,013	249,034	134,240	383,274
1995	26,394	68,861	132,333	44,218	31,759	75,977	199,405	270,017	137,698	407,715
1996	31,300	64,004	129,767	48,824	40,373	89,197	204,775	284,899	138,840	423,739
1997	48,300	63,550	146,069	51,201	43,600	94,801	199,000	298,501	141,369	439,870
1998	78,900	64,004	177,367	43,900	70,900	114,800	201,900	324,700	169,367	494,067
1999	85,300	78,302	205,765	48,700	39,200	87,900	201,200	335,200	159,665	494,865
2000	100,100	72,356	211,417	43,000	40,200	83,200	193,400	336,500	151,517	488,017
2001	68,780	64,276	167,666	47,125	46,855	93,980	200,055	315,960	145,741	461,701
2002	76,276	53,201	158,124	46,785	48,151	94,936	199,111	322,172	129,999	452,171
Growth										
5 yr avg		0.2%	2.8%				0.1%	1.1%	0.6%	1.0%
10 yr avg		-1.8%	1.4%				1.5%	3.0%	-1.0%	1.6%
Source: Globefish, Infofish										

Table 1.5 European Shrimp Landings

Units: tonnes		1990	1995	1996	1997	1998	1999	2000	1996- 2000	1990- 2000	Dist/state
Coldwater species											
Iceland	Pandalus	29,749	83,529	89,633	82,627	62,700	43,000	33,500	-16.7%	1.2%	13.0%
Norway	Pandalus	62,700	38,996	41,310	41,868	56,200	64,200	66,200	11.2%	0.5%	25.7%
Germany	Crangon	8,117	11,608	15,994	19,890	14,800	17,500	17,400	8.4%	7.9%	6.8%
Netherlands	Crangon	5,552	13,912	12,067	13,054	11,900	13,800	11,500	-3.7%	7.6%	4.5%
Russia & Baltics	Pandalus	23,303	13,397	19,249	12,784	16,600	36,700	57,600	33.9%	9.5%	22.4%
Denmark	Pandalus	6,654	10,720	11,422	11,984	10,600	7,800	8,000	-5.7%	1.9%	3.1%
Faroes	Pandalus	10,598	9,468	10,583	10,868	13,400	14,800	12,200	5.2%	1.4%	4.7%
Others		5,467	7,978	9,341	6,279	14,100	13,800	10,500	5.6%	6.7%	4.1%
Coldwater species total		152,140	189,608	209,599	199,354	200,300	211,600	216,900	2.7%	3.6%	84.4%
Warmwater species											
Italy	Peneaus	22,709	10,592	9,370	9,800	6,100	7,300	12,500	3.4%	-5.8%	4.9%
Spain	Parapeneaus	18,922	17,200	25,300	27,900	58,900	25,100	21,600	4.7%	1.3%	8.4%
Greece/Portugal		3,710	3,967	5,703	5,900	5,900	6,800	6,100	9.0%	5.1%	2.4%
Warmwater species total		45,341	31,759	40,373	43,600	70,900	39,200	40,200	4.8%	-1.2%	15.6%
Total all species		197,481	221,367	249,972	242,954	271,200	250,800	257,100	3.0%	2.7%	100.0%
EU production		71,131	75,977	89,197	94,807	122,300	92,100	87,600	2.9%	2.1%	34.1%

Annex II

Table 2.1 The main OECD markets trade in shrimp - 1990-2002 (Product weight)

Units: tonnes product wt	USA imports tails***	landings* tails	Total tails	Europe EU Imports**** mostly tails	landings whole	Total	Japan Imports tails	Total OECD imports	Total OECD supply
1990	227,400	82,070	309,470	246,260	71,131	317,391	283,400	757,060	910,261
1991	244,800	77,077	321,877	273,523	76,970	350,493	284,400	802,723	956,770
1992	270,100	69,360	339,460	292,281	76,830	369,111	272,800	835,181	981,371
1993	272,600	63,504	336,104	263,033	70,634	333,667	300,500	836,133	970,271
1994	284,800	63,550	348,350	298,872	76,943	375,815	303,000	886,672	1,027,165
1995	270,900	68,861	339,761	303,117	75,977	379,094	292,900	866,917	1,011,755
1996	264,200	64,004	328,204	322,665	89,197	411,862	288,800	875,665	1,028,866
1997	294,100	63,550	357,650	316,715	94,801	411,516	267,200	878,015	1,036,366
1998	316,000	64,004	380,004	363,144	114,800	477,944	238,900	918,044	1,096,848
1999	331,700	78,302	410,002	348,034	87,900	435,934	247,300	927,034	1,093,236
2000	345,100	72,356	417,456	378,375	83,200	461,575	246,600	970,075	1,125,631
2001	400,300	64,276	464,576	363,184	93,980	457,164	245,000	1,008,484	1,166,740
2002**	468,742	53,201	521,943	363,198	94,936	458,134	246,117	1,078,057	1,226,194
Growth									
5 yr avg	6.4%	0.2%	5.4%	2.8%	-0.2%	2.1%	-1.7%	2.8%	2.4%
10 yr avg	5.0%	-1.8%	3.7%	2.9%	2.0%	2.7%	-1.5%	2.3%	2.0%
	Source: Globefish, Infofish, NMFS								
	* tropical shrimp only		** estimate based on Jan to Apr 2002data			*** some peeled some shell on		**** fresh frozen & canned/potted	

Table 2.2 Shrimp supplies balance for the main OECD markets - 1990-2002 (live weight)

Units:	USA	USA	USA	Europe EU	Europe EU	Europe EU	Japan	Total	Total
tonnes	imports	landings*	Total	Imports	landings	Total	Imports	OECD imports	OECD supply
Live weight	0.58	0.625	tails	0.83	1.00		0.65		
1990	389,550	131,312	520,862	298,497	71,131	369,628	436,000	1,124,047	1,326,490
1991	419,358	123,323	542,680	331,543	76,970	408,513	437,538	1,188,439	1,388,732
1992	462,698	110,976	573,674	354,280	76,830	431,110	419,692	1,236,670	1,424,476
1993	466,981	101,607	568,588	318,828	70,634	389,462	462,308	1,248,116	1,420,357
1994	487,880	101,680	589,560	362,269	76,943	439,212	466,154	1,316,303	1,494,926
1995	464,069	110,177	574,246	367,415	75,977	443,392	450,615	1,282,098	1,468,252
1996	452,591	102,406	554,997	391,109	89,197	480,306	444,308	1,288,008	1,479,611
1997	503,812	101,680	605,491	383,897	94,801	478,698	411,077	1,298,785	1,495,266
1998	541,328	102,406	643,733	440,175	114,800	554,975	367,538	1,349,041	1,566,246
1999	568,223	125,284	693,506	421,859	87,900	509,759	380,462	1,370,544	1,583,727
2000	591,178	115,769	706,947	458,636	83,200	541,836	379,385	1,429,199	1,628,168
2001	685,739	102,842	788,580	440,223	93,980	534,203	376,923	1,502,885	1,699,707
2002**	802,984	85,122	888,106	440,240	94,936	535,176	378,642	1,621,866	1,801,923
Growth									
5 yr avg	6.4%	0.2%	5.4%		2.8%		-1.7%	3.0%	2.6%
10 yr avg	5.0%	-1.8%	3.8%		2.9%		-1.5%	2.4%	2.0%
	Source: table 2.1								
	* tropical shrimp			** estimate based on Jan to Apr 2002 data			*** some peeled some shell on		

Table 2.3: USA Shrimp Imports 2001
Infofish 16/Mar 02/NMFS

	Shell- on tails	Peeled raw	Peeled/PTO raw/cooked	Total	
Western hemisphere					
Mexico	28,659	1,327		29,986	7.3%
Ecuador	18,114	7,525		25,639	6.2%
Venezuela	7,654			7,654	1.9%
Honduras	7,138			7,138	1.7%
Panama	4,556			4,556	1.1%
Colombia	3,011			3,011	0.7%
Other western	521	2,834		3,355	0.8%
Eastern hemisphere					
Thailand	38,100	48,881	51,497	138,478	33.7%
India	18,353	10,490	3,723	32,566	7.9%
Vietnam	12,387	13,686	7,005	33,078	8.1%
China	12,073	13,879		25,952	6.3%
Indonesia	9,033	5,580	1,141	15,754	3.8%
Bangladesh	8,243			8,243	2.0%
Myanmar	1,819			1,819	0.4%
Other	38,145	23,442	4,691	66,278	16.2%
Cold water prawns					
Canada	0		6,808	6,808	1.7%
Total	207,806	127,644	74,865	410,315	100.0%
	51%	31%	18%	100%	
Shrimp species breakdown					
White shrimp	81,726	25,565	0	107,291	26.1%
Black tiger	126,080	102,079	68,057	296,216	72.2%
Pandalids	0	0	6808	6,808	1.7%
					100.0%

Table 2.4: USA Shrimp Imports 2000
Infofish 16/Mar 02

		Shell- on tails	Peeled raw	Peeled/PTO raw/cooked		
Western hemisphere						
Mexico		27,516	1,532		29,048	7.6%
Ecuador		11,273	7,297		18,570	4.9%
Venezuela		8,262			8,262	2.2%
Honduras		3,891			3,891	1.0%
Panama		3,435			3,435	0.9%
Colombia		1,664			1,664	0.4%
Other western		630	I		630	0.2%
Eastern hemisphere						
			Error V ?			
Thailand		38,674	112,197	44,702	195,573	51.2%
India		12,732	13,045	2,578	28,355	7.4%
Vietnam		5,553	6,958	3,348	15,859	4.1%
China		3,824	13,784		17,608	4.6%
Indonesia		8,456	7,074	801	16,331	4.3%
Bangladesh		9,551			9,551	2.5%
Myanmar		1,819			1,819	0.5%
Other		16,409	5,348	814	22,571	5.9%
Cold water prawns						
Canada		0	0	9,029	9,029	2.4%
Total		153,689	167,235	61,272	382,196	100.0%
		40%	44%	16%	100%	
Shrimp species breakdown						
White shrimp		60,495	22,613	0	83,108	21.7%
Black tiger		93,194	144,622	52,243	290,059	75.9%
Pandalids		0	0	9029	9,029	2.4%
						100.0%

Table 2.5: Japan Shrimp Imports 2000-01 Infofish 1Apr 02

Shell-on tails	2000	2001	2000	2001
Western hemisphere				
Ecuador	2,609	1,990	1.1%	0.8%
Africa				
Madagascar	2,014	1,827	0.8%	0.7%
Mozambique	1,783	1,998	0.7%	0.8%
Eastern hemisphere				
Indonesia	49,795	55,617	20.2%	22.7%
India	50,005	42,991	20.3%	17.5%
Vietnam	33,098	35,664	13.4%	14.6%
Thailand	18,651	20,574	7.6%	8.4%
China	16,545	14,926	6.7%	6.1%
Philippines	8,335	8,423	3.4%	3.4%
Australia	5,282	4,965	2.1%	2.0%
Bangladesh	4,147	3,169	1.7%	1.3%
Myanmar	4,464	4,148	1.8%	1.7%
Malaysia	3,057	3,838	1.2%	1.6%
Sri Lanka	3,315	3,188	1.3%	1.3%
Other Asian	2,070	1,918	0.8%	0.8%
Cold water prawns				
Russia	8,008	9,112	3.2%	3.7%
Canada	9,224	7,812	3.7%	3.2%
Greenland	9,845	7,824	4.0%	3.2%
Argentina	3,503	4,742	1.4%	1.9%
Norway	1,575	1,872	0.6%	0.8%
Denmark	1,009	1,333	0.4%	0.5%
Iceland	1,957	1,486	0.8%	0.6%
Other	6,336	5,621	2.6%	2.3%
TOTAL	246,627	245,038	100%	100%
White shrimp	19,154	16,916	7.8%	6.9%
Black tiger	192,352	193,941	78.0%	79.1%
Pandalids	35,121	34,181	14.2%	13.9%

Table 2.6: European (EU) Fresh & Frozen Shrimp Imports (Extra EU only)

Unit: tonnes	1990	1995	1996	1997	1998	1999	1998- 1999	1995- 1998	1990- 1998	% comp
Spain	50,137	66,063	66,430	65,019	87,998	79,830	-9.3%	10.0%	7.3%	31.4%
France	26,614	34,904	36,430	34,012	39,856	35,571	-10.8%	4.5%	5.2%	14.2%
Denmark	49,808	40,103	52,544	52,133	46,270	47,962	3.7%	4.9%	-0.9%	16.5%
UK	19,223	19,564	20,192	20,524	25,646	23,259	-9.3%	9.4%	3.7%	9.2%
Italy	16,761	17,744	19,781	16,663	24,403	23,600	-3.3%	11.2%	4.8%	8.7%
Netherlands	6,621	15,979	13,331	13,732	21,131	17,284	-18.2%	9.8%	15.6%	7.5%
Belgium	10,434	16,788	17,176	17,665	15,873	18,179	14.5%	-1.9%	5.4%	5.7%
Portugal	3,579	6,261	5,482	5,646	6,506	6,753	3.8%	1.3%	7.8%	2.3%
Germany	6,468	8,256	7,679	7,000	8,132	7,076	-13.0%	-0.5%	2.9%	2.9%
Sweden		3,345	3,058	2,987	3,277	1,886	-42.4%	-0.7%		1.2%
Other	322	1,015	1,921	1,414	1,111	2,404	116.4%	3.1%	16.7%	0.4%
Growth annually	189,967	230,022	244,024	236,795	280,203	263,804	-5.9%	6.8%	5.0%	100%
		3.9%	6.1%	-3.0%	18.3%	-5.9%				

Table 2.7: European frozen tropical shrimp imports: main sources & destinations 1998

Units: tonnes Source	Spain	France	Netherlands	UK	Italy	Other EU	Total
Tunisia	2,838	359			947	48	4,192
Senegal	876	2,777			379	573	4,605
Nigeria	1,188	850	2,065			2,675	6,778
Mozambique	4,754				376	1,100	6,230
Madagascar		7,534			100	403	8,037
Panama	3,182	763				18	3,963
Colombia	3,123	2,447	147			69	5,786
Ecuador	12,685	8,807	2,914	1,148	6,312	2,608	34,474
Pakistan		354	546	2,319		2,061	5,280
India	575	495	432	2,976	1,609	1,438	7,525
Bangladesh		201	1,338	2,005		2,379	5,923
Thailand	1,205	5,293	2,219	5,654	3,023	4,979	22,373
Vietnam		389	3,395	2,167	168	3,714	9,833
Indonesia	114	1,660	727	2,657	206	2,996	8,360
Malaysia	971	687	1,039	453	3,751	1,862	8,763
China	7,677		2,047	466		1,704	11,894
Others	18,385	4,596	3,559	1,913	2,738	3,056	34,247
Total	57,573	37,212	20,428	21,758	19,609	31,683	188,263
<i>proportion of total</i>	<i>30.6%</i>	<i>19.8%</i>	<i>10.9%</i>	<i>11.6%</i>	<i>10.4%</i>	<i>16.8%</i>	<i>100.0%</i>
White shrimp *	36,323	16,003	7,173	1,614	8,014	8,795	77,922
Asian tiger shrimp *	2,865	16,613	9,696	18,231	8,857	19,832	76,094
Source: Eurostat: 030613-50, 80 & 030623-90 (penaeid & others frozen & fresh, less Argentinean exports of 17,500 tonnes (which belong in the coldwater category))							
* where the distinction can be made, based on country of origin - so the "others" category is not included							

Table 2.8: European frozen coldwater shrimp imports by EU country & source 1998

Importers	Frozen Tonnes	Canned Tonnes	Origin	Frozen Tonnes	Canned Tonnes
Denmark	47,275	23,307	Canada	14,304	4,608
Spain	34,237	-	Greenland	21,829	11,188
UK	12,515	36,117	China	3,389	
France	11,070	11,130	Faeroes	8,466	
Sweden	10,402	8,635	Norway	3,048	17,768
Netherlands	9,915	7,946	Iceland	5,632	22,103
Italy	10,087	5,030	Morocco	6,648	2,095
Belgium	4,119	8,017	Argentina	17,500	
Greece	1,135	-	Other	11,130	7,049
Germany	-	14,173			
Others	2,498	4,191			
Total	143,253	118,546		91,946	64,811
Intra EU trade	51,307	35,605			
Extra EU trade	91,946	64,811			
Tropical shrimp	-	18,130	from Thailand (11,830) Malaysia & Indonesia		
Source: Eurostat: 030613-10, 30,40 & 030623-10,31,39 (pandalus, crangon & parapenaeus, frozen & fresh)* 1605 20 Canned & potted shrimp					
*plus Argentinean imports of 17,500 tonnes (coldwater in "others" category 03061380, though they sell into Spanish market)					

Table 2.9: European (EU) Fresh & Frozen Shrimp Imports (Intra & Extra EU)

Unit: tonnes	1990	1995	1996	1997	1998	1997-1998	1995-1998	1990-1998	% comp
Spain	70,970	80,880	83,430	77,728	102,300	31.6%	8.1%	4.7%	36.5%
France	41,018	54,015	56,264	53,771	63,095	17.3%	5.3%	5.5%	22.5%
Denmark	50,028	40,451	53,122	52,997	48,319	-8.8%	6.1%	-0.4%	17.2%
UK	25,409	27,469	25,826	26,201	37,038	41.4%	10.5%	4.8%	13.2%
Italy	25,700	29,097	34,524	29,725	36,880	24.1%	8.2%	4.6%	13.2%
Netherlands	6,199	17,502	14,889	14,989	33,205	121.5%	23.8%	23.3%	11.9%
Belgium	13,094	23,351	22,117	22,115	22,130	0.1%	-1.8%	6.8%	7.9%
Portugal	7,027	10,353	10,652	11,126	12,056	8.4%	5.2%	7.0%	4.3%
Germany	10,092	11,036	10,497	10,086	11,994	18.9%	2.8%	2.2%	4.3%
Sweden	10,675	9,908	13,580	11,688	11,404	-2.4%	4.8%	0.8%	4.1%
Other	2,712	2,995	4,254	4,052	3,695	-8.8%	7.3%	3.9%	1.3%
Growth annually	262,924	307,057	329,155	314,478	382,116	21.5%	7.6%	4.8%	136%
		3.2%	7.2%	-4.5%	21.5%				

Table 2.10: European (EU) Fresh & Frozen Shrimp Imports (Intra EU)

Unit: tonnes	1990	1995	1996	1997	1998	1997-1998	1995-1998	1990-1998	% comp
Spain	20,833	14,817	17,000	12,709	14,302	12.5%	-1.2%	-4.6%	5.1%
France	14,404	19,111	19,834	19,759	23,239	17.6%	6.7%	6.2%	8.3%
Denmark	220	348	578	864	2,049	137.2%	80.6%	32.2%	0.7%
UK	6,186	7,905	5,634	5,677	11,392	100.7%	13.0%	7.9%	4.1%
Italy	8,939	11,353	14,743	13,062	12,477	-4.5%	3.2%	4.3%	4.5%
Netherlands	(422)	1,523	1,558	1,257	12,074	860.5%	99.4%		4.3%
Belgium	2,660	6,563	4,941	4,450	6,257	40.6%	-1.6%	11.3%	2.2%
Portugal	3,448	4,092	5,170	5,480	5,550	1.3%	10.7%	6.1%	2.0%
Germany	3,624	2,780	2,818	3,086	3,862	25.1%	11.6%	0.8%	1.4%
Sweden	10,675	6,563	10,522	8,701	8,127	-6.6%	7.4%	-3.4%	2.9%
Other	2,390	1,980	2,333	2,638	2,584	-2.0%	9.3%	1.0%	0.9%
Growth annually	72,957	77,035	85,131	77,683	101,913	31.2%	9.8%	4.3%	36%
		1.1%	10.5%	-8.7%	31.2%				

Table 2.11: European (EU) Canned & Potted Shrimp Imports (Extra EU)

Unit: tonnes	1990	1995	1996	1997	1998	1999	1998- 1999	1995- 1999	1990- 1998	% comp
France	4,466	3,889	3,675	3,006	4,412	3,319	-24.8%	-3.9%	-3.2%	1.6%
Denmark	18,387	22,314	21,881	20,798	21,512	24,306	13.0%	2.2%	3.1%	7.7%
UK	17,902	24,752	29,067	29,739	30,829	32,836	6.5%	7.3%	7.0%	11.0%
Netherlands	9,903	6,023	6,242	6,983	7,230	5,454	-24.6%	-2.5%	-6.4%	2.6%
Belgium	1,297	2,190	2,546	2,556	2,591	2,665	2.9%	5.0%	8.3%	0.9%
Germany	3,374	6,842	6,870	7,478	7,536	6,130	-18.7%	-2.7%	6.9%	2.7%
Sweden	-	5,153	5,734	7,154	6,553	6,935	5.8%	7.7%		2.3%
Other	964	1,932	2,626	2,206	2,278	2,585	13.5%	7.6%	11.6%	0.8%
Growth annually	56,293	73,095	78,641	79,920	82,941	84,230	1.6%	3.6%	4.6%	30%
Tropical species	19,698	17,381	18,460	17,625	20,225	19,084				
Cold water species	36,595	55,714	60,181	62,295	62,716	65,146				

Table 2.12: EUROSTAT CODES

030 613	Frozen peeled & unpeeled shrimp group	030 623	Fresh - "Non frozen peeled & unpeeled shrimp group"
030 613 10	Pandalids	030 623 10	Pandalids
030 613 30	Crangons	030 623 31	Crangons
030 613 40	Deepwater rose (parapenaeids)	030 613 39	Crangon?
030 613 50	Penaeids	030 613 90	Other non pandalid, crangon so penaeids
030 613 80	Other non penaeids inc Argentinean, also freshwater prawns?		
030 613 90	Others inc penaeids (88-96)		
1605 20	Canned & potted shrimp		
1605 20-00	in airtight containers 88-93		
1605 20-10	in airtight containers 94+		
1605 20-19	prepared/preserved, not in containers, <2kg packs		
1605 20-99	prepared/preserved, not containers, >2kg packs		

Annex III

Table 3.1 Size price relationship for white shrimp 1997-2002

USA

Indicator product: white shrimp, headless shell -on, port landed prices Gulf coast

Grade	1997	1998	1999	2000	2001	2002	Average annual price decline per grade
\$US/kg							
UN/15	17.60	17.71	18.28	21.41	19.69	12.54	-6.6%
15/20	15.58	15.84	15.42	17.25	15.80	10.47	-7.6%
21/25	13.16	13.95	12.12	14.21	13.79	8.01	-9.5%
26/30	12.10	11.95	10.25	12.21	11.73	6.51	-11.7%
31/35	10.52	9.81	8.03	11.46	10.60	6.16	-10.1%
36/40	9.50	7.33	7.33	10.32	8.32	4.40	-14.3%
41/50	8.07	6.47	6.64	9.26	7.63	4.66	-10.4%
Average	12.36	11.86	11.15	13.73	12.51	7.54	-9.4%
Average annual price decline		-4.0%	-6.0%	23.1%	-8.9%	-39.7%	
Differential between size class and the next one down							Average differential
UN/15	13%	12%	19%	24%	25%	20%	19%
15/20	18%	14%	27%	21%	15%	31%	21%
21/25	9%	17%	18%	16%	18%	23%	17%
26/30	15%	22%	28%	7%	11%	6%	15%
31/35	11%	34%	10%	11%	28%	40%	22%
36/40	18%	13%	10%	11%	9%	-6%	9%
41/50							
Between top & bottom grade	118%	174%	175%	131%	158%	169%	
Data source NMFS, USA							

Table 3.2: Price analyses for black tiger shrimp, white shrimp and freshwater prawns

	Black tiger		White shrimp		Freshwater prawn		
	Ex warehouse NY		Ex warehouse NY		IQF C&F USA		
	21/25	26/30	26/30	41/50	21/25		
Current prices in \$US per kg							
2002	12.0	10.0	10.7	8.0	5.8		
2001	12.3	11.0	13.3	9.1	7.9		
2000	15.8	13.8	14.0	11.3	11.4		
1999	13.7	11.6	13.2	9.6	10.4		
1998	16.0	13.7	14.9	9.3	12.5		
1997	14.9	13.3	15.4	11.0	11.8		
Real prices in \$US per kg (ie dlefated by 2.5% pa)							
2002	12.0	10.0	10.7	8.0	5.8		
2001	12.6	11.3	13.7	9.4	8.1		
2000	16.6	14.4	14.7	11.9	12.0		
1999	14.8	12.5	14.2	10.3	11.1		
1998	17.7	15.1	16.4	10.2	13.8		
1997	16.8	15.0	17.4	12.4	13.3		
Price change with time - annualised, current prices							
	Black tiger		White shrimp		FW prawn		
Time period	21/25	26/30	26/30	41/50	21/25		
% change 1999-2002	-4.2%	-4.7%	-6.5%	-5.9%	-17.6%		
% change 1985-2000		0.1%	2.1%				
% change 1981-2002		-0.6%	0.0%				
% change 1980's-99/2000		0.1%	1.0%				
Size grade price differentials							
	Tiger/tiger	white/tiger	white/tiger	Fresh/tiger	white/tiger	White	Fresh/white
	26-30/21-25	26-30/21-25	40-50/21-25	21-25/21-25	26-30/26-30	41-50/26-30	21-25/26-30
2002	-17%	-11%	-34%	-52%	7%	-26%	-46%
2001	-10%	8%	-26%	-36%	21%	-31%	-41%
2000	-13%	-11%	-28%	-28%	2%	-19%	-18%
1999	-15%	-4%	-30%	-24%	13%	-27%	-21%
1998	-15%	-7%	-42%	-22%	9%	-38%	-16%
1997	-11%	3%	-26%	-21%	16%	-29%	-23%

ANNEX IV: NIGERIA'S FISHERIES SECTOR AND PHYSICAL PARAMETERS

4.1 : Economic parameters of the Nigerian fishing Industry

Table 4.1.1: Unit production costs for shrimp trawling in Nigeria

(cost of a typical Nigerian freezer trawler producing whole frozen-at-sea head-on shrimp)

		\$US	
Capital cost			
Depreciation (23m shrimper, 25 year economic life)	\$750,000	30,000	
Interest charges @ 8%		60,000	
Insurance @ 2.5%		18,750	
		<u>108,750</u>	
Operating costs			
Fuel (1.2 tonnes/day @ \$230/tonne for 275 days year)		79,063	
Labour (12 crew @ \$2,000 pa)		24,000	
Maintenance & spares (say 3% of capital value)		22,500	
Overhead: skipper		8,500	
Overhead: management @10%		13,406	
		<u>147,469</u>	
		<u>256,219</u>	
Unit cost			
Catch: 6.5 tonnes per month caught, for 9 months (200kg/day)		60,000	Kg/year
Unit production cost		\$4.27	per kg
Packaging costs (2kg boxes @ \$0.23 & 20kg masters @\$0.85)		\$0.16	per kg
Freight costs to EU (\$6500 per 18tonne container)		\$0.36	per kg
Handling charges (2%)		<u>\$0.10</u>	per kg
	CIF EU price	<u>\$4.88</u>	per kg
	CIF EU tails price equiv	\$7.82	per kg
	Normal average price	\$10.00	28%
	Current price	\$7.00	-10%

Source: Cost and operational data - NITOA, interviews in Lagos and elsewhere during field work

**Table 4.1.2 Unit shrimp processing costs in
Nigeria**

(Lagos based processing plant processing thawed head-on shrimp as tails, PUD or P&D products)

Capital cost		\$US	
Depreciation (1,250sq.m.building)	\$275,000	11,000	
Interest charges @ 8%		22,000	
Insurance @ 1%		2,750	
		35,750	
Operating costs			
Labour (110 workforce @ \$1,800 pa)		198,000	
Maintenance & spares (say 3% of capital value)		8,250	
Services & energy		30,000	
Overhead: manager		10,000	
Overhead: supervisory staff (2 @ \$3,500)		7,000	
Overhead: management @10%		25,325	
		278,575	
		314,325	
Unit cost			
Throughput: (2.5 tonnes per day X 220days X 75% utilisation)	412,500		Kg/year
Unit production cost		\$0.76	per kg
Packaging costs (2kg boxes @ \$0.23 & 20kg masters @\$0.85)		\$0.16	per kg
Processing cost per kg input (whole shrimp)		\$0.92	per kg
Processing cost per kg output (shell-off tails)		\$1.67	per kg

Source: Cost and operational data - interviews in Lagos and elsewhere during field work

Table 4.2: THE NIGERIAN SHRIMP TRAWLING INDUSTRY - KEY PARAMETERS

Company	Active fleet	Processing plants	Cold stores		Location	Foreign Partner
	Freezer trawlers	Certified	Certified	Capacity		(if any)
Savannah group						
ICF	12				Apapa, Lagos	Indian
Primlaks	11				Benin City, Edo	"
ORC	11	Yes	Yes	1,000 tonnes	Ebute Metta	"
Atlantic shrimpers	9			120 tonnes	Surulere	"
Intra Fisheries Co	6			"	Isolo, Lagos	"
Universal Associates	4	Yes		"	Ijora Causeway, Lagos	"
Universal Fishing	3			"	Isolo, Lagos	"
Paramount Frozen Foods	3			"	Badagri Road, Lagos	"
Nigerian Fishing Net	2			"	Badagri Road, Lagos	"
Cosmos	2			"	Victoria Island, Lagos	"
Savannah	3		Yes	50 tonnes	Victoria Island, Lagos	"
	66					
Ocean Fisheries	18	Yes	Yes	6,000 tonnes	Apapa, Lagos	Indian
Obelawo Farcha Industries	18		Yes	N/A	Apapa, Lagos	none
Dolphine Fisheries	12			1,500 tonnes	Tin Can Island, Lagos	Chinese
Tarabaroz Fisheries	11		Yes	100 tonnes	Tin Can Island, Lagos	Russian
Banarly/Olokun	10	Yes	Yes	1,250 tonnes	Ebute Metta, Lagos	Indian
Honeywell	9			uses Banarly's	Victoria Island, Lagos	none
Benguela Fishing Industries	2			-	Kirikiri	none
	78					
Others (17 companies)	35					
Total	179	4	7	10,000	tonnes	
Other companies						
United Fisheries	Trader		Yes			

Table 4.3 Prices for shrimp & prawns in Nigeria

6-13th August 2002

Product		Cost	Weight	Product weight	Fresh wt/equiv	Notes
		Naira	Kg	\$/kg	\$/kg	
Freshwater prawns (macrobrachium)						
Whole, fresh	Epe market	3,000	9.0		2.6	all sizes
Whole, fresh	Epe market	1,100	4.0		2.1	all sizes
	Badagri					
Whole, fresh	Market	500	3.0		1.3	small
Tails (43% yield)	Epe market	3,000	3.9		6.0	all sizes
Whole individuals	Lagos reputed	50	0.1		4.8	large individuals
Whole fresh	Calabar	350	3.4		0.8	74gm average size
Average					2.9	
<i>International equivalent 21-25 count whole equiv</i>					2.5	
<i>International equivalent 21-25 count tails</i>					5.8	

Table 4.3 Prices for shrimp & prawns in Nigeria (continued)

6-13th August 2002

Product		Cost	Weight	Product weight	Fresh wt/equiv	Notes
		Naira	Kg	\$/kg	\$/kg	
Penaeids						
Fresh mixed	Ebeno	1,500	3.5		3.3	ready for drying
Dried mixed small	Ebeno	1,600	2.7	4.6	1.2	
Dried mixed small	Etina Uyo	500	0.5	7.3	1.8	inland, near Uyo
Dried mixed small	Lokoja	10	0.0	2.6	0.6	
Average					1.7	
Frozen packs	blackmarket	25,000	24.0		8.0	reputed figure in Ebeno
Frozen whole	Bonny	400	1.0		3.1	LNG residence mall
Frozen peeled tails	Bonny	700	1.0	5.4	2.2	LNG residence mall -40% meat yield
Frozen white whole 10-20	Lagos (Primlax)	4,400	2.0		16.9	7-15 count tails equiv
Frozen white whole 20-30	"	3,800	2.0		14.6	15- 22 count tails equiv
Frozen white whole 40-60	"	2,700	2.0		10.4	30-45 count tails equiv
Frozen white whole 150-200	"	700	2.0		2.7	115- 150 count tails equiv
Frozen white tails 20ct	"	4,400	2.0	16.9	6.8	85 -90/2kg
Frozen white tails 40ct	"	3,400	2.0	13.1	5.2	175-180/2kg
Frozen white tails 95ct	"	1,600	2.0	6.2	2.5	400-450/2kg
Frozen white peeled 40ct?	"	800	1.0	6.2	3.7	400-450/2kg
Average					6.9	

Product	Cost	Weight	Product	Fresh	Notes
			weight	wt/equiv	
	Naira	Kg	\$/kg	\$/kg	
<i>International equiv 10-20 count whole equiv white</i>				6.9	price discounted back to USA Gulf ex-vessel price
<i>International equivalent 10-20 count tails white</i>			11.5		
<i>International equiv 20-30 count whole equiv white</i>				5.8	
<i>International equivalent 20-30 count tails white</i>			9.6		
<i>International equiv 40-50 count whole equiv white</i>				4.8	
<i>International equivalent 40-50 count tails white</i>			8.0		
Tiger shrimp					50gm individuals = 15 ct/lb tails
Fresh P monodon	Bonny	700	0.5	10.8	
Frozen P monodon	Bonny	1,600	1	12.3	
<i>International equiv 21-25 count whole equiv monodon</i>				7.5	
<i>Internat equivalent 21-25 count tails monodon</i>			12.5		

Source: market visits

Key

130 Naira/\$US
4 dry to fresh factor

Table 4.4 Prices for fish & other seafood in Nigeria

6-13th August 2002

Product		Cost	Weight	Product	Fresh	Notes
				weight	wt/equiv	
		Naira	Kg	\$/kg	\$/kg	
Catfish		Naira	Weight (kg)	\$/kg	\$/kg	Notes
Whole, fresh	Badagri	2,000	3		5.1	
"	"	1,500	2		5.8	
"	Epe farm	2,500	5		3.8	Brood stock sale price
"	AGIP					
"	Obricom	375	1		2.9	250 -500 naira range
"	Eket farm	350	1		2.7	stated by owner
"	Banarly	300	1		2.3	
"	Lokoja	1,250	3		3.2	
"	Lokoja	500	1		3.8	
Smoked catfish	Lokoja	600	0.7	6.6	2.2	
Average					3.5	
Tilapia						
Whole fresh	Epe	600	2		2.3	large
"	AGIP					
"	Obricom	200	1		1.5	150 -250 naira range
"	Lokoja	40	0.5		0.6	small
Average					1.5	
Other						
Imported scad						
thawed	Etinam Uyo	140	3		0.4	
Local Bonga fresh	Ibeno	50	0.75		0.5	
Fish fillet frozen	Bonney LNG	600	1		4.6	
Crab frozen	"	300	1		2.3	
Squid frozen	"	600	1		4.6	
Lates whole fresh	Lokoja	11,000	40		2.1	

Source: market visits

Key 130 Naira/\$US
4 dry to fresh factor

ANNEX V: CLIMATIC PARAMETERS FOR THE NIGER DELTA REGION - RIVERS STATE (PORT HARCOURT)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual or average
Air temperature (deg C)													
Average maxima	32.8	34.1	32.8	32.5	32.1	30.0	28.6	28.5	29.1	30.2	31.1	32.9	31.2
Monthly average	27.0	28.4	28.0	27.9	27.5	26.4	25.4	25.6	25.2	25.6	27.1	26.2	26.7
Average minima	21.1	22.6	23.1	23.3	22.8	22.7	22.2	22.6	21.2	21.0	23.0	19.4	22.1
Rainfall (mm per month)	27.7	20.8	153.1	177.5	225.7	162.6	292.6	289.5	253.4	198.4	44.0	11.5	1,856.8
Evaporation (mm per month)	4.4	3.9	2.0	2.4	2.1	1.9	1.5	1.5	1.6	1.8	3.0	3.1	29.0
Water balance (mm per month)	23.3	16.9	151.1	175.1	223.6	160.8	291.1	288.1	251.9	196.6	41.0	8.4	1,827.8
Sea water temperature													
Estimate based on 3 month running average of air temperature	26.7	27.2	27.8	28.1	27.8	27.2	26.4	25.8	25.4	25.4	25.9	26.3	

Source: Department of Meteorological Services Lagos: years 1992-96, Port Harcourt station

SALINITY MEASUREMENTS TAKEN DURING THE RECONNAISSANCE

Sample area (moving from east to west)

Calabar	0 ppt	13-Aug
Ibeno (Eket)	5 ppt	10-Aug
Qua Ibo estuary mouth, Mobil Terminal, (Eket)	16 ppt	10-Aug
Bonny town seafront	22 ppt	11-Aug
Finima town creek (Bonny Island)	12 ppt	11-Aug
Open sea, Badagri shore	34 ppt	6-Aug

Annex VI. Rice production in Nigeria: 2000 & freshwater prawn potential

	Production Tons ('000s)	Proportion	Area cultivated hectares	Prawn output tons
Kaduna	603	18%	241,200	1,206
Niger	596	18%	238,400	1,192
Benue	285	9%	114,000	570
Taraba	240	7%	96,000	480
Borno	158	5%	63,200	316
Ebonyi	141	4%	56,400	282
Adamawa	159	5%	63,600	318
Nasarawa	122	4%	48,800	244
Kogi	105	3%	42,000	210
Bayels a	101	3%	40,400	202
Others 27 states)	788	24%	315,200	1,576
Total	3,298	100%	1,319,200	6,596
* Rice yield assumed to be 2.5 ton/ha (PCU, FMA)				
** 5% of farms produce prawns, 100kg/ha/yr				
Source: FMA (R&D) via FMA PCU				

One hectare, 10 pond farm growing catfish semi intensively			\$US
(with feeding and yield of 5t/ha)	7,500	capital cost	750
Operating costs			
Feed FCR of 1.2:1, feed cost \$0.7/kg 40% protein			4,200
Labour: 4 farmhands @ \$70/month			3,360
Fingerlings (30,000/ha @ \$50per1000)			1,600
Other			1,500
		Total	11,410
Revenue (@\$3/kg for 5tonnes)	5,000	kg output	15,000
Margin			3,590
Profit margin			24%
Return on capital			20%

0.1 hectare, 10 pond farm growing catfish artisanally			\$US
(with feeding and yield of 5t/ha)			
Capital related costs \$750 over 10 years	750	capital cost	75
Operating costs			
Feed FCR of 2.5:1, feed cost \$0.08/kg waste products			100
Labour: 1 farmhands @ \$70/month			-
Fingerlings (32,000/ha @ \$50per1000)			160
Other			150
		Total	485
Revenue (@\$3/kg for 5 tonnes/hectare)	500	kg output	1,500
Margin			1,015
Profit margin			68%
Return on capital			209%